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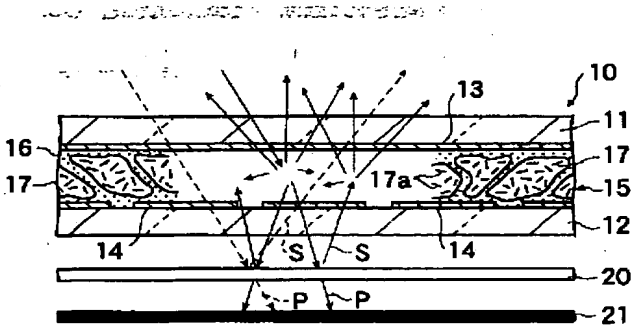
(54)【発明の名称】　液晶表示装置

(57)【要約】
【課題】入射光の散乱による明表示を充分に明るくし、しかもコントラストの良い表示を得ることができる散乱型の液晶表示装置を提供する。
【解決手段】散乱／透過型液晶セル１０の背面側に、互いに直交する反射軸と透過軸とをもち、前記反射軸に沿った偏光成分のｓ波光を反射し、前記透過軸に沿った偏光成分のｐ波光を透過させるｐ－ｓ波分離反射板２０を配置し、このｐ－ｓ波分離反射板２０の背面側に光吸収部材２１を設けた。



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【特許請求の範囲】

【請求項１】互いに対向する一対の基板の内面にそれぞれ電極が設けられ、前記一対の基板間に、前記電極間に印加される電界による液晶分子の配向状態の変化に応じて入射光を散乱および透過させる液晶層が設けられた散乱／透過型液晶セルの背面側に、互いに直交する方向に反射軸と透過軸とをもち、前方から前記液晶セルに入射してその背面に出射した光のうちの前記反射軸に沿った偏光成分のｓ波光を前記液晶セルに向けて反射し、前記透過軸に沿った偏光成分のｐ波光を背面側に透過させるｐ－ｓ波分離反射板を配置し、このｐ－ｓ波分離反射板の背面側に光吸収部材を設けたことを特徴とする液晶表示装置。

【請求項２】前記光吸収部材は、入射光のほとんどを吸収する黒色系の吸収膜であることを特徴とする請求項１に記載の液晶表示装置。

【請求項３】前記光吸収部材は、吸収軸に沿った偏光成分の光を吸収し、透過軸に沿った偏光成分の光を透過させる偏光板であり、この偏光板が、その透過軸を前記ｐ－ｓ波分離反射板の透過軸に対して交差する方向に向けて配置されていることを特徴とする請求項１に記載の液晶表示装置。

【請求項４】前記偏光板の背面側に光反射部材が設けられていることを特徴とする請求項３に記載の液晶表示装置。

【請求項５】前記液晶セルと前記ｐ－ｓ波分離反射板との間、もしくは前記液晶セルの前面側に、垂直方向に対して特定の角度範囲内の入射角で入射した光を散乱せずに出射し、それよりも大きい入射角で入射した光を散乱して出射する異方性散乱板が配置されていることを特徴とする請求項１に記載の液晶表示装置。

【請求項６】前記液晶セルは、前記一対の基板の内面にそれぞれ設けられた前記電極が互いに対向する複数の画素領域を有しており、前記一対の基板のいずれか一方に、前記複数の画素領域にそれぞれ対応する複数の色のカラーフィルタが設けられていることを特徴とする請求項１～５のいずれかに記載の液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、光の散乱を制御して表示する散乱型の液晶表示装置に関するものである。

【０００２】

【従来の技術】液晶表示装置として、光の散乱を制御して表示する散乱型のものがある。図８は従来の散乱型液晶表示装置の断面図であり、この液晶表示装置は、散乱／透過型液晶セル１と、この液晶セル１の背面側に配置された光吸収膜９とからなっている。

【０００３】前記散乱／透過型液晶セル１は、入射光を散乱および透過させるものであり、図示しない枠状のシール材を介して接合された前面側および背面側の一対の透明基板２，３と、これらの基板２，３の内面にそれぞれ設けられた透明な電極４，５と、前記一対の基板２，３間に設けられ、前記電極４，５間に印加される電界による液晶分子の配向状態の変化に応じて入射光を散乱および透過させる液晶層６とからなっている。

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【０００４】なお、図８示した散乱／透過型液晶セル１は高分子分散型のものであり、その液晶層６は液晶／高分子複合層である。この液晶／高分子複合層は、透明な高分子層７中に誘電異方性が正のネマティック液晶８を分散させたものであり、スポンジのような断面をもつようにポリマー化した高分子層７の各隙間部にそれぞれ液晶８が閉じ込められた構造をなしている。

【０００５】また、この液晶セル１は、アクティブマトリックス方式のものであり、背面側基板３の内面に設けられた電極５は、マトリックス状に配列する複数の画素電極である。これらの画素電極５はそれぞれ、前記背面側基板３の内面に各画素電極５にそれぞれ対応させて設けられた図示しない複数のＴＦＴ（薄膜トランジスタ）に接続されており、前記複数のＴＦＴは、前記背面側基板３の内面に配線された図示しないゲートラインおよびデータラインにつながっている。

【０００６】一方、前面側基板２の内面に設けられた電極４は、前記複数の画素電極５の全てに対向する一枚膜状の対向電極であり、この対向電極４と前記複数の画素電極５とが互いに対向する領域がそれぞれ画素領域となっている。

【０００７】また、前記光吸収膜９は、入射光のほとんどを吸収する黒色系のものであり、この光吸収膜９は、前記液晶セル１の背面側に、この液晶セル１のほぼ全面に対向させて配置されている。なお、図では光吸収膜９を液晶セル１の背面から離間させて示しているが、この光吸収膜９は、前記液晶セル１の背面側基板３の外面に近接または密着させて設けられている。

【０００８】この散乱型液晶表示装置は、その使用環境の光である外光（自然光や室内照明光等）を利用し、前記散乱／透過型液晶セル（高分子分散型液晶セル）１の液晶層６による光の散乱を制御して表示するものであり、入射光を前記液晶層６により散乱させて明表示を得、前記入射光を前記液晶層６を透過させて背面側の光吸収膜９で吸収することにより暗表示を得る。

【０００９】すなわち、前記液晶セル１の液晶層６である液晶／高分子複合層の液晶８の分子８ａは、電極４，５間に電圧が印加されていない無電界状態では、図８に示したようにランダムな方向を向いている。

【００１０】この無電界状態では、液晶セル１にその前面から入射した光が、図に実線矢印で示したように液晶層６の散乱作用により散乱され、その散乱光のうちの液晶セル１の前面に向かう光が前方に出射して、その領域の表示が明表示となる。なお、前記液晶層６により散乱

された光のうちの背面側に向かう光は、この液晶セル１の背面に出射して光吸収膜９により吸収される。

【００１１】また、前記液晶セル１の電極４，５間に、所定の値の電圧を印加すると、その電界により前記液晶層６の液晶分子８ａが基板２，３面に対してほぼ垂直になるように一様に配列する。

【００１２】このときは、液晶セル１にその前面から入射した光が、図に破線矢印で示したように、前記液晶層６による散乱作用をほとんど受けずに液晶セル１を透過し、その光が光吸収膜９により吸収されて、その領域の表示が暗表示となる。

【００１３】このように、上記散乱型液晶表示装置は、光の散乱を制御して表示するものであり、この散乱型液晶表示装置は、ＴＮ（ツイステッド・ネマティック）型の液晶表示装置のように光の透過を制御するための偏光板を必要としないため、外光を利用して明るい表示を得ることができる。

【００１４】なお、図８示した散乱／透過型液晶セル１は高分子分散型のものであるが、散乱／透過型液晶セルには、一対の透明基板間に、誘電異方性が正のコレステリック液晶またはコレステリック液晶とネマティック液晶の混合液晶からなる液晶層を設けた相転移型（相遷移型とも呼ばれる）のものもある。

【００１５】この相転移型液晶セルは、液晶の相転移を利用して光を散乱および透過させるもので、一対の基板の内面にそれぞれ設けられた電極間に電圧が印加されていない無電界状態では、前記液晶がコレステリック液晶相を呈しており、入射光を散乱させる。また、前記電極間に所定の値の電圧を印加すると、前記液晶がホメオトロピック配列のネマティック液晶相に転移し、入射光をほとんど散乱することなく透過させる。

【００１６】前記相転移型液晶セルを用いる散乱型液晶表示装置も、前記液晶セルの背面側に光吸収膜を配置して構成されており、前方からの入射光を前記液晶セルの液晶層により散乱させて明表示を得、前記入射光を前記液晶セルを透過させて前記光吸収膜で吸収することにより暗表示を得る。

【００１７】

【発明が解決しようとする課題】しかし、従来の散乱型液晶表示装置は、散乱／透過型液晶セル（高分子分散型または相転移型液晶セル）にその前面から入射し、液晶層により散乱された散乱光のうちの液晶セルの前面に向かう光だけが前方に出射し、液晶層の背面側に向かう散乱光は液晶セルの背面に出射して光吸収膜により吸収されるため、明表示の明るさが充分でなく、コントラストが悪い。

【００１８】この発明は、入射光の散乱による明表示を充分に明るくし、しかもコントラストの良い表示を得ることができる散乱型の液晶表示装置を提供することを目的としたものである。

【００１９】

【課題を解決するための手段】この発明の液晶表示装置は、互いに対向する一対の基板の内面にそれぞれ電極が設けられ、前記一対の基板間に、前記電極間に印加される電界による液晶分子の配向状態の変化に応じて入射光を散乱および透過させる液晶層が設けられた散乱／透過型液晶セルの背面側に、互いに直交する方向に反射軸と透過軸とをもち、前方から前記液晶セルに入射してその背面に出射した光のうちの前記反射軸に沿った偏光成分のｓ波光を前記液晶セルに向けて反射し、前記透過軸に沿った偏光成分のｐ波光を背面側に透過させるｐ－ｓ波分離反射板を配置し、このｐ－ｓ波分離反射板の背面側に光吸収部材を設けたことを特徴とするものである。

【００２０】この液晶表示装置は、その使用環境の光である外光を利用し、前記散乱／透過型液晶セルの液晶層による光の散乱を制御して表示するものであり、前記液晶セルの液晶層の液晶分子が入射光を散乱させる配向状態にあるときは、前方から前記液晶セルに入射した外光が前記液晶層により散乱される。

【００２１】そして、このときは、前記液晶層により散乱された散乱光のうちの液晶セルの前面に向かう光が前方に出射するともに、前記液晶セルの背面に出射した散乱光のうちの前記ｐ－ｓ波分離反射板の反射軸に沿った偏光成分のｓ波光がこのｐ－ｓ波分離反射板により反射され、その反射光が再び前記液晶セルにその背面から入射し、前記液晶層により再び散乱されて前方に出射し、その領域の表示が明表示となる。

【００２２】なお、前記液晶セルの背面に出射した散乱光のうち、前記ｐ－ｓ波分離反射板の透過軸に沿った偏光成分のｐ波光は、このｐ－ｓ波分離反射板を透過して前記光吸収部材により吸収される。

【００２３】すなわち、この液晶表示装置は、入射光の散乱による明表示を、前方から入射し前記液晶セルの液晶層により散乱された散乱光のうちの前方に出射する光と、前記液晶セルの背面側に出射した散乱光のうちの前記ｐ－ｓ波分離反射板により反射され、前記液晶層により再び散乱されて前方に出射する光との両方によって表示するものであり、したがって、明表示の明るさは充分である。

【００２４】また、前記液晶セルの液晶層の液晶分子が入射光を透過させる状態に配向したときは、前方から液晶セルに入射した光が前記液晶層をほとんど散乱することなく透過して液晶セルの背面側に出射し、その光のうちの前記ｐ－ｓ波分離反射板の透過軸に沿った偏光成分のｐ波光がこのｐ－ｓ波分離反射板を透過して前記光吸収部材により吸収され、その領域の表示が暗表示となる。

【００２５】ただし、この暗表示のときも、前記液晶セルの背面に出射した光のうちの前記ｐ－ｓ波分離反射板の反射軸に沿った偏光成分のｓ波光が、このｐ－ｓ波分

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離反射板により反射され、その反射光が再び前記液晶セルを透過して前方に出射するため、前記暗表示が、前記ｐ－ｓ波分離反射板を備えずに液晶セルの背面に出射した光のほとんどを光吸収部材により吸収する場合に比べて明るくなる。

【００２６】しかし、液晶表示装置の表示は、その正面方向（装置前面の法線付近の方向）から観察されるのが普通であり、外光は、表示の観察方向である正面方向に対して斜めに傾いた方向から主に入射する。

【００２７】そして、前記ｐ－ｓ波分離反射板は、その反射軸に沿った偏光成分のｓ波光のほとんどを、その入射角と同じ反射角で反射するため、前記暗表示のときに前記ｐ－ｓ波分離反射板により反射された光の出射方向は、前記正面方向に対して斜め前方、つまり表示観察観察者にはほとんど見えない方向であり、そのため、正面方向から観察される暗表示は充分な暗さである。

【００２８】したがって、この発明の液晶表示装置によれば、入射光の散乱による明表示を充分に明るくし、しかも、前記明表示と暗表示との明るさの差が充分に大きいコントラストの良い表示を得ることができる。

【００２９】

【発明の実施の形態】この発明の液晶表示装置は、上記のように、散乱／透過型液晶セルの背面側に、互いに直交する反射軸と透過軸とをもち、前記反射軸に沿った偏光成分のｓ波光を反射し、前記透過軸に沿った偏光成分のｐ波光を透過させるｐ－ｓ波分離反射板を配置し、このｐ－ｓ波分離反射板の背面側に光吸収部材を設けることにより、入射光の散乱による明表示を充分に明るくし、しかもコントラストの良い表示を得ることができるようにしたものである。

【００３０】この発明の液晶表示装置において、前記ｐ－ｓ波分離反射板の背面側に設ける光吸収部材は、入射光のほとんどを吸収する黒色系の吸収膜が好ましく、この黒色系の吸収膜を用いることにより、前記ｐ－ｓ波分離反射板を透過した光が反射されて前方に出射するのをほぼ完全に無くし、前記暗表示をより暗くすることができる。

【００３１】なお、前記光吸収部材は、吸収軸に沿った偏光成分の光を吸収し、透過軸に沿った偏光成分の光を透過させる偏光板でもよく、その場合は、前記偏光板を、その透過軸を前記ｐ－ｓ波分離反射板の透過軸に対して交差する方向に向けて配置することにより、前記ｐ－ｓ波分離反射板を透過した光を前記偏光板で吸収することができる。

【００３２】このように、前記光吸収部材に偏光板を用いる場合は、前記偏光板の背面側に光反射部材を設けてもよく、このような構成とすることにより、前記明表示をより明るくすることができる。

【００３３】すなわち、前記ｐ－ｓ波分離反射板の偏光度はあまり高くないため、前記偏光板の透過軸が前記ｐ－ｓ波分離反射板の透過軸に対して交差していても、前記ｐ－ｓ波分離反射板を透過して前記偏光板に入射した光（ｐ－ｓ波分離反射板の透過軸に沿った偏光成分のｐ波光）のうちのある程度の光が前記偏光板の背面側に透過するが、前記偏光板の背面側に光反射部材を設け、前記ｐ－ｓ波分離反射板を透過し、さらに前記偏光板を透過した光を前記光反射部材により積極的に反射させるようにすれば、この光反射部材により反射された光も前方に出射する。

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【００３４】そのため、明表示を、前記液晶セルの液晶層により散乱された光のうちの前方に出射する光と、前記ｐ－ｓ波分離反射板により反射され前記液晶層により再び散乱されて前方に出射する光と、前記光反射部材により反射され前記液晶層により再び散乱されて前方に出射する光とによって表示し、前記明表示をより明るくすることができる。

【００３５】この場合は、暗表示もある程度明るくなるが、外光は上述したように表示の観察方向である正面方向に対して斜めに傾いた方向から主に入射し、明表示のときは前記ｐ－ｓ波分離反射板および光反射部材により正面方向に対して斜め前方に反射されるため、正面方向から観察される暗表示は充分な暗さであり、したがって、明表示と暗表示との明るさの差が充分に大きいコントラストの良い表示を得ることができる。

【００３６】さらに、この発明の液晶表示装置においては、前記液晶セルと前記ｐ－ｓ波分離反射板との間、もしくは前記液晶セルの前面側に、垂直方向に対して特定の角度範囲内の入射角で入射した光を散乱せずに出射し、それよりも大きい入射角で入射した光を散乱して出射する異方性散乱板を配置するのが望ましく、このようにすることにより、表示の観察方向である正面方向により多く散乱光を出射させて明表示をさらに明るくするとともに、暗表示の際の前記ｐ－ｓ波分離反射板でのｐ波光の反射による暗表示のギラつきを抑制することができる。

【００３７】また、前記液晶セルは、一対の基板の内面にそれぞれ設けられた電極が互いに対向する複数の画素領域を有しており、前記一対の基板のいずれか一方に、前記複数の画素領域にそれぞれ対応する複数の色のカラーフィルタが設けられているものでもよく、このような液晶セルを用いることにより、明るくコントラストの良いカラー画像を表示することができる。

【００３８】

【実施例】図１はこの発明の第１の実施例を示す液晶表示装置の一部分の断面図であり、この実施例の液晶表示装置は、散乱／透過型液晶セル１０と、この液晶セル１の背面側に配置されたｐ－ｓ波分離反射板２０と、このｐ－ｓ波分離反射板２０の背面側に光吸収部材として設けられた吸収膜２１とからなっている。

【００３９】前記散乱／透過型液晶セル１０は、入射光

を散乱および透過させるものであり、図示しない枠状のシール材を介して接合された前面側および背面側の一対の透明基板１１，１２の内面にそれぞれ透明な電極１３，１４が設けられ、前記一対の基板１１，１２間に、前記電極１３，１４間に印加される電界による液晶分子の配向状態の変化に応じて入射光を散乱および透過させる液晶層１５が設けられている。

【００４０】なお、この実施例で用いた散乱／透過型液晶セル１０は高分子分散型のものであり、その液晶層１５は液晶／高分子複合層である。この液晶／高分子複合層は、透明な高分子層１６中に誘電異方性が正のネマティック液晶１７を分散させたものであり、スポンジのような断面をもつようにポリマー化した高分子層１６の各隙間部にそれぞれ液晶１７が閉じ込められた構造をなしている。

【００４１】また、この液晶セル１０は、アクティブマトリックス方式のものであり、背面側基板１２の内面に設けられた電極１４は、マトリックス状に配列する複数の画素電極である。これらの画素電極１４はそれぞれ、前記背面側基板１２の内面に各画素電極１４にそれぞれ対応させて設けられた図示しない複数のＴＦＴ（薄膜トランジスタ）に接続されており、前記複数のＴＦＴは、前記背面側基板１２の内面に配線された図示しないゲートラインおよびデータラインにつながっている。

【００４２】一方、前面側基板１１の内面に設けられた電極１３は、前記複数の画素電極１４の全てに対向する一枚膜状の対向電極であり、この対向電極１３と前記複数の画素電極１４とが互いに対向する領域がそれぞれ画素領域となっている。

【００４３】次に、前記散乱／透過型液晶セル１０の背面側に配置されたｐ－ｓ波分離反射板２０について説明する。

【００４４】図２は前記ｐ－ｓ波分離反射板２０の斜視図であり、このｐ－ｓ波分離反射板２０は、互いにほぼ直交する方向に反射軸２０ｓと透過軸２０ｐとをもっており、入射光のうちの前記反射軸２０ｓに沿った偏光成分のｓ波光を反射させ、前記透過軸２０ｐに沿った偏光成分のｐ波光を透過させる特性を有している。

【００４５】すなわち、図２に示したように、このｐ－ｓ波分離反射板２０に、その反射軸２０ｓに沿った偏光成分のｓ波光Ｓと、前記透過軸２０ｐに沿った偏光成分のｐ波光Ｐとの両方を含む光を入射させると、その入射光のうちの前記反射軸２０ｓに沿ったｓ波光Ｓはｐ－ｓ波分離反射板２０で反射され、前記透過軸２０ｐに沿ったｐ波光Ｐはｐ－ｓ波分離反射板２０を透過する。

【００４６】なお、図２には、ｐ－ｓ波分離反射板２０にその一方の面から光を入射させた例を示したが、前記ｐ－ｓ波分離反射板２０は、他方の面からの入射光に対しても同じ特性を示す。

【００４７】このｐ－ｓ波分離反射板２０は、その反射特性および透過特性が波長依存性の無い特性である無着色シートであり、その反射光は、鏡面反射光である。

【００４８】そして、前記ｐ－ｓ波分離反射板２０は、その反射軸２０ｓおよび透過軸２０ｐを任意の方向に向けて、前記液晶セル１０の背面側に、この液晶セル１０のほぼ全面に対向させて配置されている。

【００４９】また、前記吸収膜２１は、入射光のほとんどを吸収する黒色系のものであり、この吸収膜２１は、前記ｐ－ｓ波分離反射板２０の背面側に、このｐ－ｓ波分離反射板２０のほぼ全面に対向させて配置されている。

【００５０】なお、図１では、液晶セル１０とｐ－ｓ波分離反射板２０と吸収膜２１とを互いに離間させて示しているが、ｐ－ｓ波分離反射板２０は液晶セル１０の背面側基板１２の外面に近接または密着させて設けられ、吸収膜２１はｐ－ｓ波分離反射板２０の背面に近接または密着させて設けられている。

【００５１】この液晶表示装置は、その使用環境の光である外光を利用し、前記散乱／透過型液晶セル（この実施例では高分子分散型液晶セル）１０の液晶層１５による光の散乱を制御して表示するものであり、前記液晶セル１０の液晶層１５である液晶／高分子複合層の液晶１７の分子１７ａは、電極１３，１４間に電圧が印加されていない無電界状態では、図１に示したように、ランダムな方向を向いた配向状態、つまり入射光を散乱させる配向状態にある。

【００５２】このように液晶セル１０の液晶層１５の液晶分子１７ａが入射光を散乱させる配向状態にあるときは、前方から液晶セル１０に入射した光が、図１に実線矢印で示したように液晶層１５の散乱作用により散乱される。

【００５３】そして、このときは、前記液晶層１５により散乱された散乱光のうちの液晶セル１０の前面に向かう光が前方に出射するとともに、前記液晶セル１０の背面に出射した散乱光のうちの前記ｐ－ｓ波分離反射板２０の反射軸２０ｓに沿った偏光成分のｓ波光Ｓがこのｐ－ｓ波分離反射板２０により反射され、その反射光が再び液晶セル１０にその背面から入射し、前記液晶層１５により再び散乱されて前方に出射し、その領域の表示が明表示となる。

【００５４】なお、前記液晶セル１０の背面に出射した散乱光のうち、前記ｐ－ｓ波分離反射板２０の透過軸２０ｐに沿った偏光成分のｐ波光Ｐは、このｐ－ｓ波分離反射板２０を透過して前記吸収膜２１により吸収される。

【００５５】すなわち、この液晶表示装置は、入射光の散乱による明表示を、前方から入射し前記液晶セル１０の液晶層１５により散乱された散乱光のうちの前方に出射する光と、前記液晶セル１０の背面側に出射した散乱光のうちの前記ｐ－ｓ波分離反射板２０により反射さ

れ、前記液晶層１５により再び散乱されて前方に出射する光との両方によって表示するものであり、したがって、明表示の明るさは充分である。

【００５６】また、前記液晶セル１０の電極１３，１４間に、所定の値の電圧を印加すると、その電界により前記液晶層１５の液晶分子１７ａが基板１１，１２面に対してほぼ垂直になるように一様に配列し、入射光を透過させる配向状態になる。

【００５７】このように液晶セル１０の液晶層１５の液晶分子１７ａが入射光を透過させる状態に配向したときは、前方から液晶セル１０に入射した光が、図１に破線矢印で示したように前記液晶層１５をほとんど散乱することなく透過して液晶セルの背面側に出射し、その光のうちの前記ｐ－ｓ波分離反射板２０の透過軸２０ｐに沿った偏光成分のｐ波光Ｐがこのｐ－ｓ波分離反射板２０を透過して前記吸収膜２１により吸収され、その領域の表示が暗表示となる。

【００５８】ただし、この暗表示のときも、前記液晶セル１０の背面に出射した光のうちの前記ｐ－ｓ波分離反射板２０の反射軸に沿った偏光成分のｓ波光Ｓが、このｐ－ｓ波分離反射板２０により反射され、その反射光が再び液晶セル１０を透過して前方に出射するため、前記暗表示が、前記ｐ－ｓ波分離反射板２０を備えずに液晶セル１０の背面に出射した光のほとんどを吸収膜２１により吸収する場合に比べて明るくなる。

【００５９】しかし、液晶表示装置の表示は、その正面方向（装置前面の法線付近の方向）から観察されのが普通であり、外光は、表示の観察方向である正面方向に対して斜めに傾いた方向から主に入射する。

【００６０】すなわち、外光を利用して表示する表示装置は、表示の観察方向である正面方向に対じて画面の上縁側に斜めに傾いた方向を明るい外光が得られる方向に向けて使用されるのが普通であり、この実施例の液晶表示装置も、同様にして使用される。

【００６１】そして、前記ｐ－ｓ波分離反射板２０は、その反射軸２２ｓに沿った偏光成分のｓ波光Ｓのほとんどを、その入射角と同じ反射角で反射するため、前記暗表示のときに前記ｐ－ｓ波分離反射板２０により反射された光の出射方向は、前記正面方向に対して斜め前方、つまり表示観察観察者にはほとんど見えない方向であり、そのため、正面方向から観察される暗表示は充分な暗さである。

【００６２】しかも、この実施例では、前記ｐ－ｓ波分離反射板２０の背面側に設ける光吸収部材を、入射光のほとんどを吸収する黒色系の吸収膜２１としているため、前記ｐ－ｓ波分離反射板２０を透過した光が反射されて前方に出射するのをほぼ完全に無くし、前記暗表示をより暗くすることができる。

【００６３】したがって、この液晶表示装置によれば、入射光の散乱による明表示を充分に明るくし、しかも、前記明表示と暗表示との明るさの差が充分に大きいコントラストの良い表示を得ることができる。

【００６４】上記実施例の液晶表示装置と、この液晶表示装置から前記ｐ－ｓ波分離反射板２０を省略した比較装置との表示特性を比較すると、これらの装置にその前面の法線を中心とする円周の全周方向から前記法線に対して２０度の入射角で光を入射させ、出射光を正面方向（前記法線に沿った方向）から測定したときの、それぞれ装置の明表示および暗表示のときの光の反射率（入射光に対する出射光の比率）Ｒと、出射光の色度ｘ，ｙと、コントラストC_Rは、次の通りである。

【００６５】なお、前記反射率Ｒは、Al_2O_3（アルミナ）からなる白色反射板の単体での反射率を基準とし、この白色反射板の反射率を１００％とした値であり、また前記出射光の色度は、ＣＩＥ色度図上におけるｘコーディネイト値とｙコーディネイト値である。

【００６６】［比較装置］

明表示　反射率Ｒ＝５．７％、色度ｘ＝０．２７，ｙ＝０．２７

暗表示　反射率Ｒ＝１．５％、色度ｘ＝０．２８，ｙ＝０．３０

コントラストC_R＝３．９

［実施例装置］

明表示　反射率Ｒ＝８８．１％、色度ｘ＝０．３２，ｙ＝０．３３

暗表示　反射率Ｒ＝１０．０％、色度ｘ＝０．３０，ｙ＝０．３２

コントラストC_R＝８．９

このように、上記実施例の液晶表示装置は、ｐ－ｓ波分離反射板２０を省略して液晶セル１０の背面に出射した光のほとんどを吸収膜２１により吸収するようにした比較装置に比べて、暗表示のときの反射率が高いため、暗レベルが若干浮き上がるが、明表示のときの反射率が格段に高く、前記比較装置に比べて高いコントラストが得られる。

【００６７】しかも、上記実施例の液晶表示装置は、明表示および暗表示のときの出射光の色度がいずれもＣＩＥ色度図上における白（無彩色）点（ｘ＝０．３１，ｙ＝０．３２）に極く近い値であり、したがって、前記比較装置に比べて良好な白黒表示を得ることができる。

【００６８】なお、上記第１の実施例では、前記ｐ－ｓ波分離反射板２０の背面側に、光吸収部材として黒色系の吸収膜２１を設けているが、前記光吸収部材は、吸収軸に沿った偏光成分の光を吸収し、透過軸に沿った偏光成分の光を透過させる偏光板でもよい。

【００６９】図３はこの発明の第２の実施例を示す液晶表示装置の一部分の断面図であり、この実施例の液晶表示装置は、散乱／透過型液晶セル１０と、この液晶セル１の背面側に配置されたｐ－ｓ波分離反射板２０と、このｐ－ｓ波分離反射板２０の背面側に光吸収部材として

設けられた偏光板２２と、この偏光板２２の背面側に設けられた光反射部材２３とからなっている。

【００７０】なお、散乱／透過型液晶セル１０は高分子分散型のものであり、この液晶セル１０とｐ－ｓ波分離反射板２０は上記第１の実施例のものと同じであるから、重複する説明は図に同符号を付して省略する。

【００７１】この実施例において、前記偏光板２２は、その透過軸を前記ｐ－ｓ波分離反射板２０の透過軸２０ｐ（図２参照）に対して交差する方向に向けて配置されている。

【００７２】また、前記偏光板２２の背面側に配置された光反射部材２３は、例えば銀からなる鏡面反射膜であり、この光反射部材２３は前記偏光板２２の背面に近接または密着させて設けられている。

【００７３】この実施例の液晶表示装置は、前記ｐ－ｓ波分離反射板２０の背面側に設ける光吸収部材を、吸収軸に沿った偏光成分の光を吸収し、透過軸に沿った偏光成分の光を透過させる偏光板２２としたものであるが、前記偏光板２２を、その透過軸を前記ｐ－ｓ波分離反射板２０の透過軸２０ｐに対して交差する方向に向けて配置しているため、前記ｐ－ｓ波分離反射板２０を透過した光（ｐ－ｓ波分離反射板２０の透過軸２０ｐに沿った偏光成分のｐ波光）を前記偏光板２２で吸収することができる。

【００７４】なお、前記偏光板２２の透過軸と前記ｐ－ｓ波分離反射板２０の透過軸２０ｐとの交差角度は任意に設定すればよいが、好ましい交差角度は、９０度またはそれに近い角度であり、前記偏光板２２の透過軸を前記ｐ－ｓ波分離反射板２０の透過軸２０ｐに対してほぼ直交させることにより、前記ｐ－ｓ波分離反射板２０を透過した光を前記偏光板２２により効率良く吸収することができる。

【００７５】しかも、この実施例では、前記偏光板２２の背面側に光反射部材２３を設けているため、前記明表示をより明るくすることができる。

【００７６】すなわち、前記ｐ－ｓ波分離反射板２０の偏光度はあまり高くないため、前記偏光板２２の透過軸が前記ｐ－ｓ波分離反射板２０の透過軸２０ｐに対して交差していても、前記ｐ－ｓ波分離反射板２０を透過して前記偏光板２２に入射した光（ｐ－ｓ波分離反射板２０の透過軸２０ｐに沿った偏光成分のｐ波光）Ｐのうちのある程度の光が、図３に矢印で示したように前記偏光板２２の背面側に透過する。

【００７７】そして、この実施例では、前記偏光板２２の背面側に光反射部材２３を設けることにより、前記ｐ－ｓ波分離反射板２０を透過し、さらに前記偏光板２２を透過した光を前記光反射部材２３により積極的に反射させるようにしているため、この光反射部材２３により反射された光も前方に出射する。

【００７８】そのため、この実施例によれば、明表示を、前記液晶セル１０の液晶層１５により散乱された光のうちの前方に出射する光と、前記ｐ－ｓ波分離反射板２０により反射され前記液晶層１５により再び散乱されて前方に出射する光と、前記光反射部材２３により反射され前記液晶層１５により再び散乱されて前方に出射する光とによって表示し、前記明表示をより明るくすることができる。

【００７９】この場合は、暗表示もある程度明るくなるが、外光は上述したように表示の観察方向である正面方向に対して斜めに傾いた方向から主に入射し、明表示のときは前記ｐ－ｓ波分離反射板２０および光反射部材２３により正面方向に対して斜め前方に反射されるため、正面方向から観察される暗表示は充分な暗さであり、したがって、明表示と暗表示との明るさの差が充分に大きいコントラストの良い表示を得ることができる。

【００８０】この実施例の液晶表示装置において、前記偏光板２２の透過軸と前記ｐ－ｓ波分離反射板２０の透過軸２０ｐとの交差角度は、上述したように９０度またはそれに近い角度に設定するのが好ましく、このようにすることより、前記ｐ－ｓ波分離反射板２０を透過した光を前記偏光板２２により効率良く吸収して、前記明表示と暗表示との明るさの差を大きくし、コントラストの良い表示を得ることができる。

【００８１】すなわち、前記偏光板２２をその透過軸を前記ｐ－ｓ波分離反射板２０の透過軸２０ｐと平行にして配置した液晶表示装置と、前記偏光板２２をその透過軸を前記ｐ－ｓ波分離反射板２０の透過軸２０ｐと直交させて配置した液晶表示装置との表示特性を比較すると、これらの装置にその前面の法線を中心とする円周の全周方向から前記法線に対して２０度の入射角で光を入射させ、出射光を正面方向（前記法線に沿った方向）から測定したときの、明表示および暗表示のときの光の反射率（入射光に対する出射光の比率）Ｒと、出射光の色度ｘ，ｙと、コントラストＣ$_R$は、次の通りである。

【００８２】なお、前記反射率Ｒは、Al_2O_3からなる白色反射板の単体での反射率を基準とし、この白色反射板の反射率を１００％とした値であり、また前記出射光の色度は、ＣＩＥ色度図上におけるｘコーディネイト値とｙコーディネイト値である。

【００８３】［偏光板とｐ－ｓ波分離反射板の透過軸平行］

明表示　反射率Ｒ＝１４６．９％、色度ｘ＝０．３１，ｙ＝０．３２

暗表示　反射率Ｒ＝　８２．３％、色度ｘ＝０．３２，ｙ＝０．３４

コントラストＣ$_R$＝１．８

［偏光板とｐ－ｓ波分離反射板の透過軸直交］

明表示　反射率Ｒ＝８８．４％、色度ｘ＝０．３２，ｙ＝０．３３

暗表示　反射率Ｒ＝１１．２％、色度ｘ＝０．３２，ｙ

＝０．３４
コントラストＣＲ＝７．９
このように、この実施例の液晶表示装置は、偏光板２２の透過軸とｐ－ｓ波分離反射板２０の透過軸２０ｐとの交差角度を９０度（直交）にしたときに、コントラストが最も高くなり、前記透過軸の交差角度を小さく（平行に近く）するのにともなってコントラストが低下する。

【００８４】したがって、前記偏光板２２の透過軸と前記ｐ－ｓ波分離反射板２０の透過軸２０ｐとの望ましい交差角度は、９０度またはそれに近い角度であり、このように前記透過軸の交差角度を設定することより、高いコントラストを得ることができる。

【００８５】なお、前記偏光板２２の透過軸と前記ｐ－ｓ波分離反射板２０の透過軸２０ｐとの望ましい交差角度は、９０度以下で０度よりも大きい範囲で任意に選ぶことができ、この交差角度を選択することにより、明表示および暗表示の明るさとコントラストを任意に設定することができる。

【００８６】図４はこの発明の第３の実施例を示す液晶表示装置の一部分の断面図であり、この実施例の液晶表示装置は、散乱／透過型液晶セル１０と、この液晶セル１の背面側に配置されたｐ－ｓ波分離反射板２０と、前記液晶セル１０と前記ｐ－ｓ波分離反射板２０との間に配置された異方性散乱板２４と、前記ｐ－ｓ波分離反射板２０の背面側に光吸収部材として設けられた黒色系の吸収膜２１とからなっている。

【００８７】なお、散乱／透過型液晶セル１０は高分子分散型のものであり、この液晶セル１０とｐ－ｓ波分離反射板２０および光吸収部材として設けられた吸収膜２１は上記第１の実施例のものと同じであるから、重複する説明は図に同符号を付して省略する。

【００８８】図５は前記異方性散乱板２４の側面図であり、この異方性散乱板２４は、図に一点鎖線で示した垂直方向Ｈに対して特定の角度範囲θ内の入射角で入射した光を図に実線矢印で示すように散乱せずに出射し、それよりも大きい入射角で入射した光を図に破線矢印で示すように散乱して出射する特性を有している。なお、この異方性散乱板２４の散乱せずに出射する光の角度範囲θは例えば３０度（垂直方向Ｈに対して１５度）である。

【００８９】この実施例の液晶表示装置によれば、液晶セル１０とｐ－ｓ波分離反射板２０との間に前記異方性散乱板２４を配置しているため、前方から前記液晶セル１０に入射して液晶層１５により散乱された光のうちの前記液晶セル１０の背面側に出射した光を、図５に実線矢印で示したように、前記異方性散乱板２４により垂直方向Ｈに向かう光が多くなるように集光し、さらにｐ－ｓ波分離反射板２０により反射された光（ｓ波光）を、再び前記異方性散乱板２４により垂直方向Ｈに向かう光が多くなるように集光して前記液晶層１５にその背面側から入射させることができ、したがって、表示の観察方向である正面方向により多くの散乱光を出射させ、明表示をさらに明るくすることができる。

【００９０】また、この液晶表示装置では、暗表示のときも、前方から入射し前記液晶セル１０の液晶層１５を透過して背面側に出射した光が前記異方性散乱板２４により垂直方向Ｈに向かう光が多くなるように集光し、さらに前記ｐ－ｓ波分離反射板２０により反射された光が再び前記異方性散乱板２４により垂直方向Ｈに向かう光が多くなるように集光するため、正面方向に出射する光が多くなり、暗表示がある程度明るくなるが、その反面、出射光が前記異方性散乱板２４により散乱された光であるため、暗表示の際の前記ｐ－ｓ波分離反射板でのｐ波光の反射による暗表示のギラつきを抑制することができる。

【００９１】この液晶表示装置に、その前面の法線を中心とする円周の全周方向から前記法線に対して２０度の入射角で光を入射させ、出射光を正面方向（前記法線に沿った方向）から測定したときの、それぞれ装置の明表示および暗表示のときの光の反射率（入射光に対する出射光の比率）Ｒと、出射光の色度ｘ，ｙと、コントラストＣＲは、次の通りである。

【００９２】なお、ここで用いた異方性散乱板２４は、「ＭＦＸ１５１５」の商品名で市販されている住友化学社製の異方性散乱板であり、前記反射率Ｒは、Al_2O_3からなる白色反射板の単体での反射率を基準とし、この白色反射板の反射率を１００％とした値であり、また前記出射光の色度は、ＣＩＥ色度図上におけるｘコーディネイト値とｙコーディネイト値である。

【００９３】明表示　反射率Ｒ＝９２．１％、色度ｘ＝０．３２，ｙ＝０．３３
暗表示　反射率Ｒ＝２５．４％、色度ｘ＝０．３０，ｙ＝０．３１
コントラストＣＲ＝３．６
このように、この実施例の液晶表示装置は、上述した第１の実施例の液晶表示装置に比べればコントラストがある程度低下するが、表示の観察方向である正面方向により多く散乱光を出射させることができるため、表示をさらに明るくするとともに、暗表示の際のｐ－ｓ波分離反射板２０でのｐ波光の反射による暗表示のギラつきを抑制することができる。

【００９４】なお、上記第３の実施例では、前記液晶セル１０とｐ－ｓ波分離反射板２０との間に異方性散乱板２４を配置しているが、この異方性散乱板２４は、図６に示した第４の実施例のように、液晶セル１０の前面側に配置してもよく、この実施例によっても、表示の観察方向である正面方向により多く散乱光を出射させ、表示をさらに明るくするとともに、暗表示の際のｐ－ｓ波分離反射板２０でのｐ波光の反射による暗表示のギラつきを抑制することができる。

【００９５】この実施例のように液晶セル１０の前面側に異方性散乱板２４を配置した液晶表示装置の明表示および暗表示のときの光の反射率Ｒと、出射光の色度ｘ，ｙと、コントラストC_Rは、次の通りである。

【００９６】明表示　反射率Ｒ＝９３．４%、色度ｘ＝０．３２，ｙ＝０．３３

暗表示　反射率Ｒ＝３０．３%、色度ｘ＝０．３０，ｙ＝０．３０

コントラストC_R＝２．７

図７は、この発明の第５の実施例を示す液晶表示装置の一部分の断面図であり、この実施例の液晶表示装置は、散乱／透過型液晶セル１０に、その複数の画素領域にそれぞれ対応する複数の色のカラーフィルタ、例えば赤、緑、青の３色のカラーフィルタ１８Ｒ，１８Ｇ，１８Ｂを備えさせたものである。

【００９７】すなわち、この実施例で用いた散乱／透過型液晶セル１０は、一対の基板１１，１２の内面にそれぞれ設けられた電極１３，１４が互いに対向する複数の画素領域を有しており、前記一対の基板１１，１２のいずれか一方、例えば前面側基板１１の内面に、前記複数の画素領域にそれぞれ対応させて、赤、緑、青の３色のカラーフィルタ１８Ｒ，１８Ｇ，１８Ｂを設けたものである。

【００９８】なお、前記散乱／透過型液晶セル１０は高分子分散型のものであり、この液晶セル１０は、前記カラーフィルタ１８Ｒ，１８Ｇ，１８Ｂを備えた点を除けば上述した第１の実施例のものと同じである。またｐ－ｓ波分離反射板２０および光吸収部材として設けられた吸収膜２１も第１の実施例のものと同じである。

【００９９】この実施例の液晶表示装置によれば、散乱／透過型液晶セル１０どして、その複数の画素領域にそれぞれ対応する赤、緑、青の３色のカラーフィルタ１８Ｒ，１８Ｇ，１８Ｂを備えたものを用いているため、明るくコントラストの良いフルカラー画像を表示することができる。

【０１００】上記実施例では、液晶セル１０の前面側基板１１の内面にカラーフィルタ１８Ｒ，１８Ｇ，１８Ｂを設けているが、前記カラーフィルタ１８Ｒ，１８Ｇ，１８Ｂは背面側基板１２の内面に設けてもよく、このようにすることにより、光の散乱による明表示を、前記液晶セル１０の液晶層１５により散乱された散乱光のうちの前方に出射する非着色の光と、前記前記カラーフィルタ１８Ｒ，１８Ｇ，１８Ｂの色に着色して液晶セル１０の背面側に出射し、ｐ－ｓ波分離反射板２０により反射されて前記液晶層１５により再び散乱された散乱光のうちの前方に出射する光との両方によって表示し、さらに明るいフルカラー画像を表示することができる。

【０１０１】なお、前記カラーフィルタ１８Ｒ，１８Ｇ，１８Ｂを備えた散乱／透過型液晶セル１０は、上述した第１～第４の実施例の液晶表示装置のいずれに用いてもよい。

【０１０２】また、前記散乱／透過型液晶セル１０は、高分子分散型のものに限らず、一対の透明基板間に、誘電異方性が正のコレステリック液晶またはコレステリック液晶とネマティック液晶の混合液晶からなる液晶層を設けた相転移型のものでもよい。

【０１０３】さらに、前記散乱／透過型液晶セル１０は、アクティブマトリックス方式のものに限らず、単純マトリックス方式のものでもよく、また、白黒表示の液晶表示装置の場合は、セグメント方式のものでもよい。

【０１０４】

【発明の効果】この発明の液晶表示装置は、散乱／透過型液晶セルの背面側に、互いに直交する反射軸と透過軸とをもち、前記反射軸に沿った偏光成分のｓ波光を反射し、前記透過軸に沿った偏光成分のｐ波光を透過させるｐ－ｓ波分離反射板を配置し、このｐ－ｓ波分離反射板の背面側に光吸収部材を設けたものであるため、入射光の散乱による明表示を充分に明るくし、しかもコントラストの良い表示を得ることができる。

【０１０５】この発明の液晶表示装置において、前記ｐ－ｓ波分離反射板の背面側に設ける光吸収部材は、入射光のほとんどを吸収する黒色系の吸収膜が好ましく、この黒色系の吸収膜を用いることにより、前記ｐ－ｓ波分離反射板を透過した光が反射されて前方に出射するのをほぼ完全に無くし、前記暗表示をより暗くすることができる。

【０１０６】なお、前記光吸収部材は、吸収軸に沿った偏光成分の光を吸収し、透過軸に沿った偏光成分の光を透過させる偏光板でもよく、その場合は、前記偏光板を、その透過軸を前記ｐ－ｓ波分離反射板の透過軸に対して交差する方向に向けて配置することにより、前記ｐ－ｓ波分離反射板を透過した光を前記偏光板で吸収することができる。

【０１０７】このように、前記光吸収部材に偏光板を用いる場合は、前記偏光板の背面側に光反射部材を設けてもよく、このような構成とすることにより、前記明表示をより明るくすることができる。

【０１０８】この場合は、暗表示もある程度明るくなるが、外光は表示の観察方向である正面方向に対して斜めに傾いた方向から主に入射し、明表示のときは前記ｐ－ｓ波分離反射板および光反射部材により正面方向に対して斜め前方に反射されるため、正面方向から観察される暗表示は充分な暗さであり、したがって、明表示と暗表示との明るさの差が充分に大きいコントラストの良い表示を得ることができる。

【０１０９】さらに、この発明の液晶表示装置においては、前記液晶セルと前記ｐ－ｓ波分離反射板との間、もしくは前記液晶セルの前面側に、垂直方向に対して特定の角度範囲内の入射角で入射した光を散乱せずに出射し、それよりも大きい入射角で入射した光を散乱して出

射する異方性散乱板を配置するのが望ましく、このようにすることにより、表示の観察方向である正面方向により多く散乱光を出射させて、表示をさらに明るくするとともに、暗表示の際の前記ｐ－ｓ波分離反射板でのｐ波光の反射による暗表示のギラつきを抑制することができる。

【０１１０】また、前記液晶セルは、一対の基板の内面にそれぞれ設けられた電極が互いに対向する複数の画素領域を有しており、前記一対の基板のいずれか一方に、前記複数の画素領域にそれぞれ対応する複数の色のカラーフィルタが設けられているものでもよく、このような液晶セルを用いることにより、明るくコントラストの良い多色カラー画像を表示することができる。

【図面の簡単な説明】

【図１】この発明の第１の実施例を示す液晶表示装置の一部分の断面図。

【図２】ｐ－ｓ波分離反射板２０の斜視図。

【図３】この発明の第２の実施例を示す液晶表示装置の一部分の断面図。

【図４】この発明の第３の実施例を示す液晶表示装置の一部分の断面図。

【図５】異方性散乱板の側面図。

【図６】この発明の第４の実施例を示す液晶表示装置の一部分の断面図。

【図７】この発明の第５の実施例を示す液晶表示装置の一部分の断面図。

【図８】従来の散乱型液晶表示装置の一部分の断面図。

【符号の説明】

１０…散乱／透過型液晶セル（高分子分散型液晶セル）

１１，１２…基板

１３，１４…電極

１５…液晶層（液晶／高分子複合層）

１８Ｒ，１８Ｇ，１８Ｂ…カラーフィルタ

２０…ｐ－ｓ波分離反射板２０

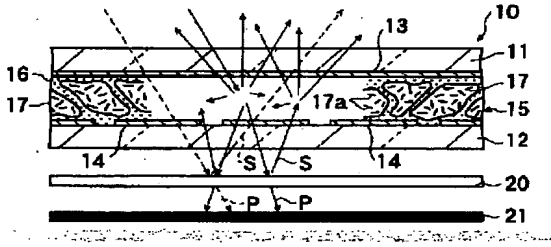
２１…吸収膜（光吸収部材）

２２…偏光板（光吸収部材）

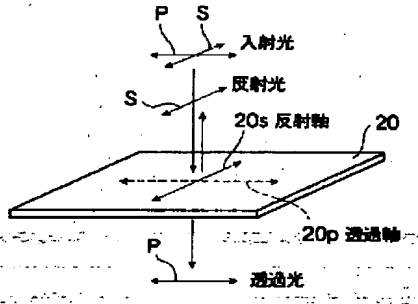
２３…光反射部材

２４…異方性散乱板

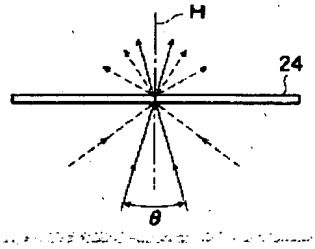
【図１】



【図２】



【図５】



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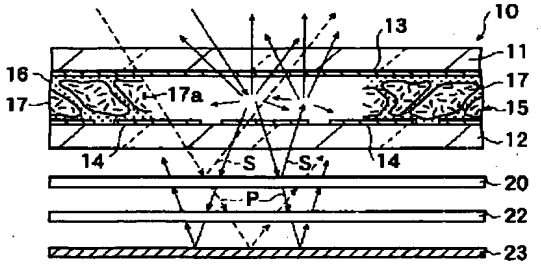
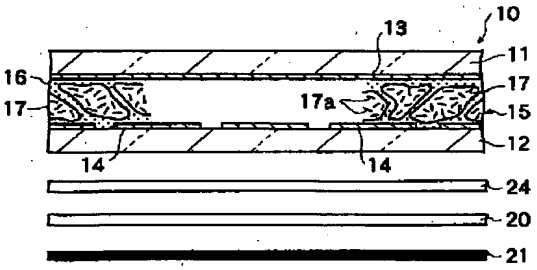
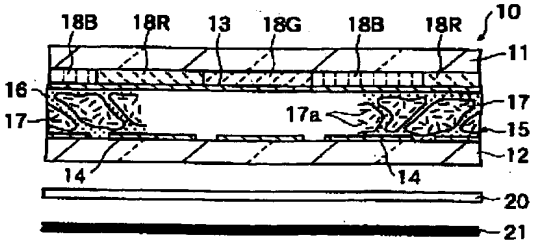


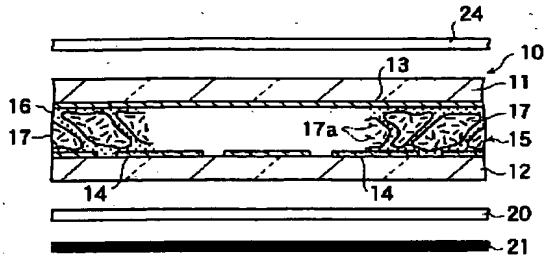
【図４】



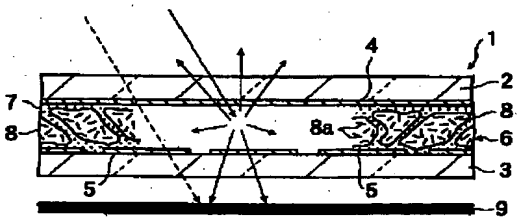
【図７】



【図６】



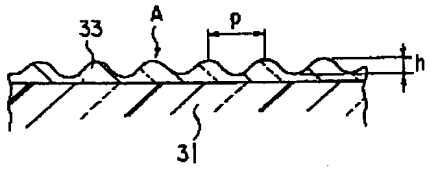
【図８】



【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第６部門第２区分
【発行日】平成１３年１０月３１日（２００１．１０．３１）

【公開番号】特開平７－３１８９２９
【公開日】平成７年１２月８日（１９９５．１２．８）
【年通号数】公開特許公報７－３１９０
【出願番号】特願平６－１１６８９９
【国際特許分類第７版】
G02F 1/1335 520
1/136 500
【ＦＩ】
G02F 1/1335 520
1/136 500

【手続補正書】
【提出日】平成１３年２月２０日（２００１．２．２０）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】請求項１
【補正方法】変更
【補正内容】
【請求項１】外光を利用し表面側から入射する光を反射させて表示する反射型表示機能と、光源からの光を裏面側から入射させて表示する透過型表示機能とを有する液晶表示装置であって、
表裏一対の透明基板間に液晶を挟持させた液晶セルと、この液晶セルの表面側に配置された第１の偏光板と、前記液晶セルの裏面側に配置された第２の偏光板とからなり、
かつ、前記液晶セルの裏面側の基板の内面に、入射光を反射させる反射膜に入射光を透過させる複数の開口が形成されてなる半透過反射膜が設けられていることを特徴とする液晶表示装置。
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】００１２
【補正方法】変更
【補正内容】
【００１２】
【課題を解決するための手段】本発明の液晶表示装置は、表裏一対の透明基板間に液晶を挟持させた液晶セルと、この液晶セルの表面側に配置された第１の偏光板と、前記液晶セルの裏面側に配置された第２の偏光板とからなり、かつ、前記液晶セルの裏面側の基板の内面に、入射光を反射させる反射膜に入射光を透過させる複数の開口が形成されてなる半透過反射膜が設けられていることを特徴とするものである。
【手続補正３】
【補正対象書類名】明細書
【補正対象項目名】００７０
【補正方法】変更
【補正内容】
【００７０】なお、前記位相差板４０は液晶セル１０の表面（表面側基板１２の外面）に接着され、表面側偏光板３１は前記位相差板４０の表面に接着されており、また裏面側偏光板３２は液晶セル１０の裏面（裏面側基板１１の外面）に接着されている。
【手続補正４】
【補正対象書類名】図面
【補正対象項目名】図９
【補正方法】変更
【補正内容】
【図９】



PATENT ABSTRACTS OF JAPAN

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G02F 1/1335

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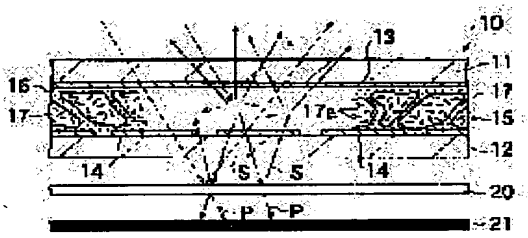
(71)Applicant : CASIO COMPUT CO LTD
(72)Inventor : ONO TOSHIOMI

(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a scattering type liquid crystal display device that a bright display by scattering of incident light is enough enhanced and a display with good contrast can be obtd.
SOLUTION: A p-s wave separation reflector 20 is disposed on the back face side of a scattering/transmission type liquid crystal cell 10. The reflector 20 has a reflection axis and transmission axis perpendicular to each other, reflects s-wave light having the polarized light component along the reflection axis and transmits p-wave light having the polarized light component along the transmission axis. A light-absorbing member 21 is disposed on the back face side of the p-s wave separation reflector 20.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

[Claim(s)]
[Claim 1] An electrode is prepared in the inside of the substrate of the pair which counters mutually, respectively. Between the substrates of said pair To the tooth-back side of dispersion/transparency mold liquid crystal cell in which the liquid crystal layer which it responds [layer] to change of the orientation condition of the liquid crystal molecule by the electric field impressed to inter-electrode [said], and makes incident light scatter about and penetrate was prepared Have a reflective shaft and a transparency shaft in the direction which intersects perpendicularly mutually, and carry out incidence to said liquid crystal cell from the front, and turn to said liquid crystal cell s **** of the polarization component in alignment with said reflective shaft of the light which carried out outgoing radiation, and it reflects in the tooth back. The liquid crystal display characterized by having arranged the p-s wave separation reflecting plate which makes p **** of the polarization component in alignment with said transparency shaft penetrate to a tooth-back side, and preparing a light absorption member in the tooth-back side of this p-s wave separation reflecting plate.
[Claim 2] Said light absorption member is a liquid crystal display according to claim 1 characterized by being the absorption film of the black system which absorbs most incident light.
[Claim 3] Said light absorption member is a liquid crystal display according to claim 1 which is the polarizing plate which makes the light of the polarization component which absorbed the light of the polarization component in alignment with an absorption shaft, and met the transparency shaft penetrate, and is characterized by arranging this polarizing plate towards the direction which crosses that transparency shaft to the transparency shaft of said p-s wave separation reflecting plate.
[Claim 4] The liquid crystal display according to claim 3 characterized by preparing the light reflex member in the tooth-back side of said polarizing plate.
[Claim 5] The liquid crystal display according to claim 1 characterized by arranging the anisotropy scattered plate which are scattered about and carries out outgoing radiation of the light which carried out outgoing radiation of the light which carried out incidence between said liquid crystal cell and said p-s wave separation reflecting plate or to the front-face side of said liquid crystal cell by the incident angle of specific include-angle within the limits to the perpendicular direction, without being scattered about, and carried out incidence by the larger incident angle than it.
[Claim 6] Said liquid crystal cell is a liquid crystal display according to claim 1 to 5 characterized by preparing the color filter of two or more colors with which said electrode prepared in the inside of the substrate of said pair, respectively has two or more pixel fields which counter mutually, and corresponds to either of the substrates of said pair to said two or more pixel fields, respectively.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display of the dispersion mold which controls and displays dispersion of light.
[0002]
[Description of the Prior Art] There is a thing of the dispersion mold which controls and displays dispersion of light as a liquid crystal display. Drawing 8 is the sectional view of the conventional dispersion mold liquid crystal display, and this liquid crystal display consists of a dispersion/transparency mold liquid crystal cell 1 and light absorption film 9 arranged at the tooth-back side of this liquid crystal cell 1.
[0003] The transparence substrates 2 and 3 of the pair by the side of the front face joined through the sealant of the shape of a frame which said dispersion/transparency mold liquid crystal cell 1 does not make scatter about for it and penetrate incident light, and is not illustrated, and a tooth back, It consists of a liquid crystal layer 6 which it is prepared [layer] between the transparent electrodes 4 and 5 prepared in the inside of these substrates 2 and 3, respectively, the substrate 2 of said pair, and 3, it responds [layer] to change of the orientation condition of said electrode 4 and the liquid crystal molecule by the electric field impressed among five, and makes incident light scatter about and penetrate.
[0004] In addition, dispersion/transparency mold liquid crystal cell 1 which **8**(ed) is the thing of macromolecule distributed process input output equipment, and the liquid crystal layer 6 is liquid crystal / macromolecule compound layer. This liquid crystal / giant-molecule compound layer are making the structure where liquid crystal 8 was confined in each clearance section of the giant-molecule layer 7 polymer-ized so that a dielectric anisotropy might distribute the forward

pneumatic liquid crystal 8 in the transparent giant-molecule layer 7 and might have a cross section like sponge in, respectively.

[0005] Moreover, this liquid crystal cell 1 is the thing of an active-matrix method, and the electrodes 5 prepared in the inside of the tooth-back side substrate 3 are two or more pixel electrodes arranged in the shape of a matrix. These pixel electrodes 5 are connected to two or more TFT(s) (thin film transistor) which each pixel electrode 5 was made to correspond to the inside of said tooth-back side substrate 3, respectively, and were prepared, respectively and which are not illustrated, and said two or more TFT(s) are connected with the gate line and data line which were wired by the inside of said tooth-back side substrate 3 and which are not illustrated.

[0006] On the other hand, the electrode 4 prepared in the inside of the front-face side substrate 2 is a counterelectrode of the shape of one-sheet film which counters said two or more pixel electrodes 5 of all, and the field where this counterelectrode 4 and said two or more pixel electrodes 5 counter mutually is a pixel field, respectively.

[0007] moreover, the thing of the black system in which said light absorption film 9 absorbs most incident light -- it is -- this light absorption film 9 -- the tooth-back side of said liquid crystal cell 1 -- this liquid crystal cell 1 -- the whole surface is made to counter mostly and it is arranged. In addition, although the light absorption film 9 is made to estrange from the tooth back of a liquid crystal cell 1 and is shown by a diagram, this light absorption film 9 is approached or stuck on the external surface of the tooth-back side substrate 3 of said liquid crystal cell 1, and is prepared in it.

[0008] This dispersion mold liquid crystal display uses the outdoor daylight (natural light, indoor illumination light, etc.) which is the light of that operating environment. Dispersion of the light by the liquid crystal layer 6 of said dispersion/transparency mold liquid crystal cell (polymer dispersed liquid crystal cel) 1 is controlled and displayed, incident light is scattered by said liquid crystal layer 6, clear display is obtained, and a dark display is obtained by making said liquid crystal layer 6 penetrate, and absorbing said incident light by the light absorption film 9 by the side of a tooth back.

[0009] That is, in the state of the non-electric field by which the electrical potential difference is not impressed between an electrode 4 and 5, molecule 8a of the liquid crystal 8 of the liquid crystal / macromolecule compound layer which is the liquid crystal layer 6 of said liquid crystal cell 1 has turned to the random direction, as shown in drawing 8.

[0010] In the state of this non-electric field, the light which carried out incidence to the liquid crystal cell 1 from that front face will be scattered about according to a dispersion operation of the liquid crystal layer 6, as the continuous-line arrow head showed to drawing, the light which goes to the front face of the liquid crystal cell 1 of that scattered light will carry out outgoing radiation ahead, and the display of that field will be clear display. In addition, outgoing radiation of the light which goes to the tooth-back side of the light scattered about by said liquid crystal layer 6 is carried out to the tooth back of this liquid crystal cell 1, and it is absorbed with the light absorption film 9.

[0011] Moreover, if the electrical potential difference of a predetermined value is impressed between the electrode 4 of said liquid crystal cell 1, and 5, it will arrange uniformly so that liquid crystal molecule 8a of said liquid crystal layer 6 may become almost perpendicular to the 2 or 3rd page of a substrate by the electric field.

[0012] At this time, the light which carried out incidence to the liquid crystal cell 1 from that front face will penetrate a liquid crystal cell 1, without hardly receiving the dispersion operation by said liquid crystal layer 6, as the broken-line arrow head showed to drawing, that light will be absorbed with the light absorption film 9, and the display of that field will be a dark display.

[0013] Thus, the above-mentioned dispersion mold liquid crystal display controls and displays dispersion of light, and since this dispersion mold liquid crystal display does not need the polarizing plate for controlling transparency of light like the liquid crystal display of TN (Twisted Nematic) mold, a bright display can be obtained using outdoor daylight.

[0014] In addition, although dispersion/transparency mold liquid crystal cell 1 which **8**(ed) is the thing of macromolecule distributed process input output equipment, there is also a thing of a phase transition mold (called a phase transition mold) which prepared the liquid crystal layer which a dielectric anisotropy becomes from forward cholesteric liquid crystal, or cholesteric liquid crystal and the liquid crystal mixture of a pneumatic liquid crystal between the transparence substrates of a pair in dispersion/transparency mold liquid crystal cell.

[0015] This phase transition mold liquid crystal cell uses the phase transition of liquid crystal, makes light scatter about and penetrate, and in the state of the non-electric field by which the electrical potential difference is not impressed to inter-electrode [which was prepared in the inside of the substrate of a pair, respectively], said liquid crystal is presenting the cholesteric-liquid-crystal

phase, and it scatters incident light. Moreover, it is made to penetrate, if the electrical potential difference of a predetermined value is impressed to inter-electrode [said], without said liquid crystal's transferring to the pneumatic liquid crystal phase of a HOMEOTORO pick array, and scattering it about in most incident light.

[0016] The dispersion mold liquid crystal display using said phase transition mold liquid crystal cell also arranges the light absorption film, and is constituted at the tooth-back side of said liquid crystal cell, the incident light from the front is scattered by the liquid crystal layer of said liquid crystal cell, clear display is obtained, and a dark display is obtained by making said liquid crystal cell penetrate and absorbing said incident light by said light absorption film.

[0017]

[Problem(s) to be Solved by the Invention] However, since outgoing radiation of the scattered light which only the light which goes to the front face of the liquid crystal cell of the scattered lights which carried out incidence of the conventional dispersion mold liquid crystal display to dispersion/transparency mold liquid crystal cell (macromolecule distributed process input output equipment or phase transition mold liquid crystal cell) from the front face, and were scattered about by the liquid crystal layer carries out outgoing radiation ahead, and goes to the tooth-back side of a liquid crystal layer is carried out to the tooth back of a liquid crystal cell and it is absorbed with the light absorption film, its brightness of clear display is not enough and its contrast is bad.

[0018] This invention makes bright enough clear display by dispersion of incident light, and aims at offering the liquid crystal display of the dispersion mold which can moreover obtain the good display of contrast.

[0019]

[Means for Solving the Problem] An electrode is prepared in the inside of the substrate of a pair with which the liquid crystal display of this invention counters mutually, respectively. To the tooth-back side of dispersion/transparency mold liquid crystal cell where the liquid crystal layer which it responds [layer] to change of the orientation condition of the liquid crystal molecule by the electric field impressed to inter-electrode [said], and makes incident light scatter about and penetrate was prepared between the substrates of said pair Have a reflective shaft and a transparency shaft in the direction which intersects perpendicularly mutually, and carry out incidence to said liquid crystal cell from the front, and turn to said liquid crystal cell s **** of the polarization component in alignment with said reflective shaft of the light which carried out outgoing radiation, and it reflects in the tooth back. The p-s wave separation reflecting plate which makes p **** of the polarization component in alignment with said transparency shaft penetrate to a tooth-back side is arranged, and it is characterized by preparing a light absorption member in the tooth-back side of this p-s wave separation reflecting plate.

[0020] This liquid crystal display uses the outdoor daylight which is the light of that operating environment, and controls and displays dispersion of the light by the liquid crystal layer of said dispersion/transparency mold liquid crystal cell, and when the liquid crystal molecule of the liquid crystal layer of said liquid crystal cell is in the orientation condition of scattering incident light, the outdoor daylight which carried out incidence to said liquid crystal cell from the front is scattered about by said liquid crystal layer.

[0021] and the light which goes to the front face of the liquid crystal cell of the scattered lights scattered about by said liquid crystal layer carries out outgoing radiation ahead at this time -- both s **** of the polarization component in alignment with the reflective shaft of said p-s wave separation reflecting plate of the scattered lights which carried out outgoing radiation is reflected in the tooth back of said liquid crystal cell by this p-s wave separation reflecting plate. The reflected light carries out incidence to said liquid crystal cell from the tooth back again, it will be again scattered about by said liquid crystal layer, outgoing radiation will be carried out ahead, and the display of the field will be clear display.

[0022] In addition, p **** of the polarization component which met the tooth back of said liquid crystal cell among the scattered lights which carried out outgoing radiation at the transparency shaft of said p-s wave separation reflecting plate penetrates this p-s wave separation reflecting plate, and is absorbed by said light absorption member.

[0023] Namely, the light which carries out outgoing radiation ahead of the scattered lights which this liquid crystal display carried out incidence of the clear display by dispersion of incident light from the front, and were scattered about by the liquid crystal layer of said liquid crystal cell, It is reflected by said p-s wave separation reflecting plate of the scattered lights which carried out outgoing radiation to the tooth-back side of said liquid crystal cell, and displays by both light which is again scattered about by said liquid crystal layer, and carries out outgoing radiation ahead, and the brightness of clear display is [therefore] enough.

[0024] Moreover, when the liquid crystal molecule of the liquid crystal layer of said liquid crystal cell

changes orientation into the condition of making incident light penetrating Penetrate without scattering about the light which carried out incidence to the liquid crystal cell from the front in most said liquid crystal layers, and outgoing radiation is carried out to the tooth-back side of a liquid crystal cell. p **** of the polarization component in alignment with the transparency shaft of said p-s wave separation reflecting plate of that light will penetrate this p-s wave separation reflecting plate, it will be absorbed by said light absorption member, and the display of that field will be a dark display.

[0025] However, s **** of the polarization component which met the tooth back of said liquid crystal cell at the reflective shaft of said p-s wave separation reflecting plate of the light which carried out outgoing radiation also at the time of this dark display It is reflected by this p-s wave separation reflecting plate, and in order that that reflected light may penetrate said liquid crystal cell again and may carry out outgoing radiation ahead, said dark display becomes bright compared with the case where most light which carried out outgoing radiation is absorbed by the light absorption member, at the tooth back of a liquid crystal cell, without having said p-s wave separation reflecting plate.

[0026] However, the display of a liquid crystal display is observed from [the] a transverse plane (direction near the normal of the front face of equipment), ** is common and incidence of the outdoor daylight is mainly carried out from the direction to which it inclined aslant to the direction of a transverse plane which is the observation direction of a display.

[0027] And since said p-s wave separation reflecting plate reflects most s **** of the polarization component in alignment with the reflective shaft by the same angle of reflection as the incident angle, the direction of light of outgoing radiation reflected by said p-s wave separation reflecting plate at the time of said dark display is the direction which does not look almost to the slanting front, i.e., a display observation observer, to said direction of a transverse plane, therefore the dark display observed from a transverse plane is sufficient darkness.

[0028] Therefore, according to the liquid crystal display of this invention, clear display by dispersion of incident light can be made bright enough, and, moreover, the difference of the brightness of said clear display and dark display can obtain the good display of contrast large enough.

[0029]

[Embodiment of the Invention] The liquid crystal display of this invention as mentioned above to the tooth-back side of dispersion/transparency mold liquid crystal cell Have the reflective shaft and transparency shaft which intersect perpendicularly mutually, and s **** of the polarization component in alignment with said reflective shaft is reflected. By arranging the p-s wave separation reflecting plate which makes p **** of the polarization component in alignment with said transparency shaft penetrate, and preparing a light absorption member in the tooth-back side of this p-s wave separation reflecting plate Clear display by dispersion of incident light is made bright enough, and it enables it to obtain the good display of contrast moreover.

[0030] The light absorption member prepared in the tooth-back side of said p-s wave separation reflecting plate in the liquid crystal display of this invention has the desirable absorption film of the black system which absorbs most incident light, by using the absorption film of this black system, can lose nearly completely the light which penetrated said p-s wave separation reflecting plate being reflected, and carrying out outgoing radiation ahead, and can give said dark indication darker.

[0031] In addition, said light-absorption member absorbs the light of the polarization component in alignment with an absorption shaft, and the polarizing plate which makes the light of the polarization component in alignment with a transparency shaft penetrate is sufficient as it, and it can absorb the light which penetrated said p-s wave separation reflecting plate with said polarizing plate by arranging said polarizing plate in that case towards the direction which crosses the transparency shaft to the transparency shaft of said p-s wave separation reflecting plate.

[0032] Thus, when using a polarizing plate for said light absorption member, a light reflex member may be prepared in the tooth-back side of said polarizing plate, and said clear display can be made brighter by considering as such a configuration.

[0033] Namely, since the degree of polarization of said p-s wave separation reflecting plate is not not much high, Although a certain amount of light of the light (p **** of the polarization component in alignment with the transparency shaft of a p-s wave separation reflecting plate) which penetrated said p-s wave separation reflecting plate, and carried out incidence to said polarizing plate penetrates to the tooth-back side of said polarizing plate even if the transparency shaft of said polarizing plate crosses to the transparency shaft of said p-s wave separation reflecting plate If it is made to reflect positively the light which prepared the light reflex member in the

tooth-back side of said polarizing plate, penetrated said p-s wave separation reflecting plate, and penetrated said polarizing plate further by said light reflex member, outgoing radiation also of the light reflected by this light reflex member will be carried out ahead.

[0034] Therefore, it can display by the light which is reflected by the light which is reflected by the light which carries out outgoing radiation ahead of the light scattered about by the liquid crystal layer of said liquid crystal cell in clear display, and said p-s wave separation reflecting plate, is again scattered about by said liquid crystal layer, and carries out outgoing radiation ahead, and said light reflex member, is again scattered about by said liquid crystal layer, and carries out outgoing radiation ahead, and said clear display can be made brighter.

[0035] In this case, although a dark display also becomes to some extent bright Since incidence of the outdoor daylight is mainly carried out from the direction to which it inclined aslant to the direction of a transverse plane which is the observation direction of a display as mentioned above, and it is reflected ahead [slanting] by said p-s wave separation reflecting plate and the light reflex member to the direction of a transverse plane at the time of clear display, The dark display observed from a transverse plane is sufficient darkness, therefore can obtain the good display of contrast with the difference of the brightness of clear display and a dark display large enough.

[0036] Furthermore, it sets to the liquid crystal display of this invention. Between said liquid crystal cell and said p-s wave separation reflecting plate or to the front face side of said liquid crystal cell When it is desirable to arrange the anisotropy scattered plate which are scattered about and carries out outgoing radiation of the light which carried out outgoing radiation of the light which carried out incidence by the incident angle of specific include-angle within the limits to the perpendicular direction, without being scattered about, and carried out incidence by the larger incident angle than it and it does in this way While carrying out many outgoing radiation of the scattered light according to the direction of a transverse plane which is the observation direction of a display and making clear display still brighter, the moire of the dark display by reflection of p **** in said p-s wave separation reflecting plate in the case of a dark display can be controlled.

[0037] Moreover, said liquid crystal cell can display the bright good color picture of contrast by having two or more pixel fields where the electrode prepared in the inside of the substrate of a pair, respectively counters mutually, preparing the color filter of two or more colors which corresponds to either of the substrates of said pair to said two or more pixel fields, respectively, and using such a liquid crystal cell.

[0038]

[Example] Drawing 1 is some sectional views of the liquid crystal display in which the 1st example of this invention is shown, and the liquid crystal display of this example consists of dispersion/transparency mold liquid crystal cell 10, a p-s wave separation reflecting plate 20 arranged at the tooth-back side of this liquid crystal cell 1, and absorption film 21 prepared in the tooth-back side of this p-s wave separation reflecting plate 20 as a light absorption member.

[0039] Said dispersion/transparency mold liquid crystal cell 10 is a thing which makes incident light scatter about and penetrate. The respectively transparent electrodes 13 and 14 are formed in the inside of the transparence substrates 11 and 12 of the pair by the side of the front face joined through the sealant of the shape of a frame which is not illustrated, and a tooth back. The liquid crystal layer 15 which it responds [layer] to change of the orientation condition of said electrode 13 and the liquid crystal molecule by the electric field impressed among 14, and makes incident light scatter about and penetrate between the substrate 11 of said pair and 12 is formed.

[0040] In addition, dispersion/transparency mold liquid crystal cell 10 used in this example is the thing of macromolecule distributed process input output equipment, and that liquid crystal layer 15 is liquid crystal / macromolecule compound layer. This liquid crystal / giant-molecule compound layer are making the structure where liquid crystal 17 was confined in each clearance section of the giant-molecule layer 16 polymer-ized so that a dielectric anisotropy might distribute the forward pneumatic liquid crystal 17 in the transparent giant-molecule layer 16 and might have a cross section like sponge in, respectively.

[0041] Moreover, this liquid crystal cell 10 is the thing of an active-matrix method, and the electrodes 14 prepared in the inside of the tooth-back side substrate 12 are two or more pixel electrodes arranged in the shape of a matrix. These pixel electrodes 14 are connected to two or more TFT(s) (thin film transistor) which each pixel electrode 14 was made to correspond to the inside of said tooth-back side substrate 12, respectively, and were prepared, respectively and which are not illustrated, and said two or more TFT(s) are connected with the gate line and data line which were wired by the inside of said tooth-back side substrate 12 and which are not illustrated.

[0042] On the other hand, the electrode 13

prepared in the inside of the front-face side substrate 11 is a counterelectrode of the shape of one-sheet film which counters said two or more pixel electrodes 14 of all, and the field where this counterelectrode 13 and said two or more pixel electrodes 14 counter mutually is a pixel field, respectively.

[0043] Next, the p-s wave separation reflecting plate 20 arranged at the tooth-back side of said dispersion/transparency mold liquid crystal cell 10 is explained.

[0044] the direction in which drawing 2 is the perspective view of said p-s wave separation reflecting plate 20, and this p-s wave separation reflecting plate 20 intersects perpendicularly mostly mutually -- 20s of reflective shafts, and transparency shaft 20p -- **** -- it gets down, s **** of the polarization component in alignment with 20s of said reflective shafts of the incident light is reflected, and it has the property of making p **** of the polarization component in alignment with said transparency shaft 20p penetrating.

[0045] Namely, s **** S of the polarization component which met this p-s wave separation reflecting plate 20 at 20s of that reflective shaft as shown in drawing 2 If incidence of the light containing both p **** P of the polarization component in alignment with said transparency shaft 20p is carried out, s **** S in alignment with 20s of said reflective shafts of the incident light will be reflected with the p-s wave separation reflecting plate 20, and p **** P in alignment with said transparency shaft 20p will penetrate the p-s wave separation reflecting plate 20.

[0046] In addition, although the example to which incidence of the light was carried out from the field of one of these was shown in the p-s wave separation reflecting plate 20 at drawing 2 , said p-s wave separation reflecting plate 20 shows the same property also to the incident light from the field of another side.

[0047] This p-s wave separation reflecting plate 20 is a non-colored sheet that reflection property and whose transparency property are properties without a wavelength dependency, and that reflected light is specular light.

[0048] and said p-s wave separation reflecting plate 20 -- 20s of that reflective shaft, and transparency shaft 20p -- the direction of arbitration -- turning -- the tooth-back side of said liquid crystal cell 10 -- this liquid crystal cell 10 -- the whole surface is made to counter mostly and it is arranged.

[0049] moreover, the thing of the black system in which said absorption film 21 absorbs most incident light -- it is -- this absorption film 21 -- the tooth-back side of said p-s wave separation reflecting plate 20 -- this p-s wave separation reflecting plate 20 -- the whole surface is made to counter mostly and it is arranged.

[0050] In addition, although a liquid crystal cell 10, the p-s wave separation reflecting plate 20, and the absorption film 21 of each other are made to estrange and are shown by drawing 1 , the p-s wave separation reflecting plate 20 is approached or stuck on the external surface of the tooth-back side substrate 12 of a liquid crystal cell 10, and it is prepared, and the absorption film 21 is approached or stuck at the tooth back of the p-s wave separation reflecting plate 20, and is prepared in it.

[0051] This liquid crystal display is what uses the outdoor daylight which is the light of that operating environment, and controls and displays dispersion of the light by the liquid crystal layer 15 of said dispersion/transparency mold liquid crystal cell (this example polymer dispersed liquid crystal cel) 10. In the state of the non-electric field by which the electrical potential difference is not impressed between an electrode 13 and 14, molecule 17a of the liquid crystal 17 of the liquid crystal / macromolecule compound layer which is the liquid crystal layer 15 of said liquid crystal cell 10 is in the orientation condition which turned to the random direction, i.e., the orientation condition of scattering incident light, as shown in drawing 1 .

[0052] Thus, when liquid crystal molecule 17a of the liquid crystal layer 15 of a liquid crystal cell 10 is in the orientation condition of scattering incident light, the light which carried out incidence to the liquid crystal cell 10 from the front is scattered about according to a dispersion operation of the liquid crystal layer 15, as the continuous-line arrow head showed to drawing 1 .

[0053] and the light which goes to the front face of the liquid crystal cell 10 of the scattered lights scattered about by said liquid crystal layer 15 carries out outgoing radiation ahead at this time -- both s **** S of the polarization component in alignment with 20s of reflective shafts of said p-s wave separation reflecting plate 20 of the scattered lights which carried out outgoing radiation is reflected in the tooth back of said liquid crystal cell 10 by this p-s wave separation reflecting plate 20. The reflected light carries out incidence to a liquid crystal cell 10 from the tooth back again, it will be again scattered about by said liquid crystal layer 15, outgoing radiation will be carried out ahead, and the display of the field will be clear display.

[0054] In addition, p **** P of the polarization component which met the tooth back of said liquid crystal cell 10 among the scattered lights which carried out outgoing radiation at transparency

shaft 20p of said p-s wave separation reflecting plate 20 penetrates this p-s wave separation reflecting plate 20, and is absorbed with said absorption film 21.

[0055] Namely, the light which carries out outgoing radiation ahead of the scattered lights which this liquid crystal display carried out incidence of the clear display by dispersion of incident light from the front, and were scattered about by the liquid crystal layer 15 of said liquid crystal cell 10, It is reflected by said p-s wave separation reflecting plate 20 of the scattered lights which carried out outgoing radiation to the tooth-back side of said liquid crystal cell 10, and displays by both light which is again scattered about by said liquid crystal layer 15, and carries out outgoing radiation ahead, and the brightness of clear display is [therefore] enough.

[0056] Moreover, if the electrical potential difference of a predetermined value is impressed between the electrode 13 of said liquid crystal cell 10, and 14, it arranges uniformly so that liquid crystal molecule 17a of said liquid crystal layer 15 may become almost perpendicular to the 11 or 12th page of a substrate by the electric field, and will be in the orientation condition of making incident light penetrating.

[0057] Thus, when liquid crystal molecule 17a of the liquid crystal layer 15 of a liquid crystal cell 10 changes orientation into the condition of making incident light penetrating The light which carried out incidence to the liquid crystal cell 10 from the front penetrates without almost scattering said liquid crystal layer 15 on drawing 1 , as the broken-line arrow head showed, and carries out outgoing radiation to the tooth-back side of a liquid crystal cell. p **** P of the polarization component in alignment with transparency shaft 20p of said p-s wave separation reflecting plate 20 of that light will penetrate this p-s wave separation reflecting plate 20, it will be absorbed with said absorption film 21, and the display of that field will be a dark display.

[0058] However, s **** S of the polarization component which met the tooth back of said liquid crystal cell 10 at the reflective shaft of said p-s wave separation reflecting plate 20 of the light which carried out outgoing radiation also at the time of this dark display It is reflected by this p-s wave separation reflecting plate 20, and in order that that reflected light may penetrate a liquid crystal cell 10 again and may carry out outgoing radiation ahead, said dark display becomes bright compared with the case where most light which carried out outgoing radiation is absorbed with the absorption film 21, at the tooth back of a liquid crystal cell 10, without having said p-s wave separation reflecting plate 20.

[0059] However, the display of a liquid crystal display is observed from [the] a transverse plane (direction near the normal of the front face of equipment), ** is common and incidence of the outdoor daylight is mainly carried out from the direction to which it inclined aslant to the direction of a transverse plane which is the observation direction of a display.

[0060] That is, as for the display displayed using outdoor daylight, it is common to use the direction which inclined to the upper limb side of a screen aslant to the direction of a transverse plane which is the observation direction of a display towards the direction where bright outdoor daylight is obtained, and the liquid crystal display of this example is used similarly.

[0061] And since said p-s wave separation reflecting plate 20 reflects most s **** S of the polarization component in alignment with 22s of the reflective shaft by the same angle of reflection as the incident angle, The direction of outgoing radiation of light reflected by said p-s wave separation reflecting plate 20 at the time of said dark display is a direction which does not look almost to the slanting front, i.e., a display observation observer, to said direction of a transverse plane, therefore the dark display observed from a transverse plane is sufficient darkness.

[0062] And in this example, since the light absorption member prepared in the tooth-back side of said p-s wave separation reflecting plate 20 is used as the absorption film 21 of the black system which absorbs most incident light, it can lose nearly completely the light which penetrated said p-s wave separation reflecting plate 20 being reflected, and carrying out outgoing radiation ahead, and said dark indication can be given darker.

[0063] Therefore, according to this liquid crystal display, clear display by dispersion of incident light can be made bright enough, and, moreover, the difference of the brightness of said clear display and dark display can obtain the good display of contrast large enough.

[0064] If the display property of the liquid crystal display of the above-mentioned example and the comparison equipment which omitted said p-s wave separation reflecting plate 20 from this liquid crystal display is compared Incidence of the light is carried out [of the periphery centering on the normal of the front face] to these equipments from the perimeter by the incident angle of 20 degrees to said normal. When outgoing radiation light is measured from a transverse plane (direction which met said normal), the reflection factor (ratio of the outgoing radiation light to incident light) R of the light at the time of the

clear display of equipment and a dark display, the chromaticity x of outgoing radiation light, y, and the contrast CR are as follows, respectively.

[0065] In addition, said reflection factor R is, the value which made 100% the reflection factor of this white reflecting plate on the basis of the reflection factor in the simple substance of the white reflecting plate which consists of aluminum 2O3 (alumina), and the chromaticity of said outgoing radiation light is x coordination value and y coordination value on a CIE chromaticity diagram.

[0066] [Comparison equipment]

Clear display R= 5.7% of reflection factors, a chromaticity x= 0.27, y=0.27 dark display R= 1.5% of reflection factors, a chromaticity x= 0.28, y=0.30 contrast CR=3.9[example equipment]

clear display R= 88.1% of reflection factors, a chromaticity x= 0.32, and y=0.33 dark display R= 10.0% of reflection factors, a chromaticity x= 0.30, and y=0.32 contrast CR=8.9 -- in this way Although dark level comes floating a little compared with the comparison equipment it was made to absorb most light which omitted the p-s wave separation reflecting plate 20, and carried out outgoing radiation to the tooth back of a liquid crystal cell 10 with the absorption film 21 since the reflection factor at the time of a dark display is high, the liquid crystal display of the above-mentioned example the reflection factor at the time of clear display is alike and high, and high contrast is acquired compared with said comparison equipment.

[0067] and the white [liquid crystal display / of the above-mentioned example / chromaticity / each / of the outgoing radiation light at the time of clear display and a dark display] (achromatic color) point on a CIE chromaticity diagram (x= 0.31, y= 0.32) -- **** -- it is a near value, therefore good monochrome display can be obtained compared with said comparison equipment.

[0068] In addition, although the absorption film 21 of a black system is formed in the tooth-back side of said p-s wave separation reflecting plate 20 as a light absorption member in the 1st example of the above, the polarizing plate which makes the light of the polarization component which absorbed the light of the polarization component in alignment with an absorption shaft, and met the transparency shaft penetrate is sufficient as said light absorption member.

[0069] Drawing 3 is some sectional views of the liquid crystal display in which the 2nd example of this invention is shown, and the liquid crystal display of this example consists of dispersion/transparency mold liquid crystal cell 10, the p-s wave separation reflecting plate 20 arranged at the tooth-back side of this liquid crystal cell 1, a polarizing plate 22 prepared in the tooth-back side of this p-s wave separation reflecting plate 20 as a light absorption member, and a light reflex member 23 prepared in the tooth-back side of this polarizing plate 22.

[0070] In addition, dispersion/transparency mold liquid crystal cell 10 is the thing of macromolecule distributed process input output equipment, and since this liquid crystal cell 10 and the p-s wave separation reflecting plate 20 are the same as the thing of the 1st example of the above, the overlapping explanation attaches and omits a same sign to drawing.

[0071] In this example, said polarizing plate 22 is arranged towards the direction which crosses that transparency shaft to transparency shaft 20p (refer to drawing 2) of said p-s wave separation reflecting plate 20.

[0072] Moreover, the light reflex member 23 arranged at the tooth-back side of said polarizing plate 22 is specular reflection film which consists of silver, and this light reflex member 23 is approached or stuck at the tooth back of said polarizing plate 22, and is prepared in it.

[0073] Although considered as the polarizing plate 22 which makes the light of the polarization component which the liquid crystal display of this example absorbed the light of the polarization component which met the absorption shaft in the light absorption member prepared in the tooth-back side of said p-s wave separation reflecting plate 20, and met the transparency shaft penetrate Since said polarizing plate 22 is arranged towards the direction which crosses the transparency shaft to transparency shaft 20p of said p-s wave separation reflecting plate 20, The light (p **** of the polarization component in alignment with transparency shaft 20p of the p-s wave separation reflecting plate 20) which penetrated said p-s wave separation reflecting plate 20 is absorbable with said polarizing plate 22.

[0074] Although what is necessary is just to set the crossover include angle of the transparency shaft of said polarizing plate 22, and transparency shaft 20p of said p-s wave separation reflecting plate 20 as arbitration, in addition, a desirable crossover include angle It is an include angle near 90 degrees or it, and the light which penetrated said p-s wave separation reflecting plate 20 can be efficiently absorbed with said polarizing plate 22 by making the transparency shaft of said polarizing plate 22 intersect perpendicularly mostly to transparency shaft 20p of said p-s wave separation reflecting plate 20.

[0075] And in this example, since the light reflex member 23 is formed in the tooth-back side of said polarizing plate 22, said clear display can be made

brighter.

[0076] Namely, since the degree of polarization of said p-s wave separation reflecting plate 20 is not not much high, Even if the transparency shaft of said polarizing plate 22 crosses to transparency shaft 20p of said p-s wave separation reflecting plate 20 A certain amount of light of the light (p **** of the polarization component in alignment with transparency shaft 20p of the p-s wave separation reflecting plate 20) P which penetrated said p-s wave separation reflecting plate 20, and carried out incidence to said polarizing plate 22 penetrates to the tooth-back side of said polarizing plate 22, as the arrow head showed to drawing 3 .

[0077] And in this example, since he is trying to reflect positively the light which penetrated said p-s wave separation reflecting plate 20, and penetrated said polarizing plate 22 further by forming the light reflex member 23 in the tooth-back side of said polarizing plate 22 by said light reflex member 23, outgoing radiation also of the light reflected by this light reflex member 23 is carried out ahead.

[0078] Therefore, the light which carries out outgoing radiation of the clear display ahead of the light scattered about by the liquid crystal layer 15 of said liquid crystal cell 10 according to this example, It can be reflected by said p-s wave separation reflecting plate 20, it can be again scattered about by said liquid crystal layer 15, and can display by the light which carries out outgoing radiation ahead, and the light which is reflected by said light reflex member 23, is again scattered about by said liquid crystal layer 15, and carries out outgoing radiation ahead, and said clear display can be made brighter.

[0079] In this case, although a dark display also becomes to some extent bright Since incidence of the outdoor daylight is mainly carried out from the direction to which it inclined aslant to the direction of a transverse plane which is the observation direction of a display as mentioned above, and it is reflected ahead [slanting] by said p-s wave separation reflecting plate 20 and the light reflex member 23 to the direction of a transverse plane at the time of clear display, The dark display observed from a transverse plane is sufficient darkness, therefore can obtain the good display of contrast with the difference of the brightness of clear display and a dark display large enough.

[0080] In the liquid crystal display of this example the crossover include angle of the transparency shaft of said polarizing plate 22, and transparency shaft 20p of said p-s wave separation reflecting plate 20 The light which penetrated said p-s wave separation reflecting plate 20 is efficiently absorbed with said polarizing plate 22 from it being desirable to set it as the include angle near 90 degrees or it, as mentioned above, and doing in this way. The difference of the brightness of said clear display and dark display can be enlarged, and the good display of contrast can be obtained.

[0081] Namely, the liquid crystal display which set the transparency shaft to transparency shaft 20p of said p-s wave separation reflecting plate 20 at parallel, and has arranged said polarizing plate 22, If a display property with the liquid crystal display which transparency shaft 20p of said p-s wave separation reflecting plate 20 and the transparency shaft were made to cross at right angles, and has arranged said polarizing plate 22 is compared Incidence of the light is carried out [of the periphery centering on the normal of the front face] to these equipments from the perimeter by the incident angle of 20 degrees to said normal. The reflection factor (ratio of the outgoing radiation light to incident light) R of the light at the time of the clear display and the dark display when measuring outgoing radiation light from a transverse plane (direction which met said normal), the chromaticity x of outgoing radiation light, y, and the contrast CR are as follows.

[0082] In addition, said reflection factor R is the value which made 100% the reflection factor of this white reflecting plate on the basis of the reflection factor in the simple substance of the white reflecting plate which consists of aluminum 2O3, and the chromaticity of said outgoing radiation light is x coordination value and y coordination value on a CIE chromaticity diagram.

[0083] [Transparency shaft parallel of a polarizing plate and a p-s wave separation reflecting plate] Clear display R= 146.9% of reflection factors, a chromaticity x= 0.31, y=0.32 dark display Reflection factor R= Transparency shaft rectangular cross] of 82.3%, a chromaticity x= 0.32, and a y=0.34 contrast CR=1.8[polarizing plate and a p-s wave separation reflecting plate

clear display R= 88.4% of reflection factors, a chromaticity x= 0.32, and y=0.33 dark display R= 11.2% of reflection factors, a chromaticity x= 0.32, and y=0.34 contrast CR=7.9 -- in this way When the liquid crystal display of this example makes the crossover include angle of the transparency shaft of a polarizing plate 22, and transparency shaft 20p of the p-s wave separation reflecting plate 20 90 degrees (rectangular cross), contrast falls in connection with contrast becoming the highest and making the crossover include angle of said transparency shaft small (in parallel near).

[0084] Therefore, the desirable crossover include angle of the transparency shaft of said polarizing plate 22 and transparency shaft 20p of said p-s wave separation reflecting plate 20 is an include angle near 90 degrees or it, and can acquire

contrast higher than setting up the crossover include angle of said transparency shaft in this way.

[0085] In addition, the desirable crossover include angle of the transparency shaft of said polarizing plate 22 and transparency shaft 20p of said p-s wave separation reflecting plate 20 is 90 or less degrees, and can set the brightness and contrast of clear display and a dark display as arbitration by being able to choose it as arbitration in the large range, and choosing this crossover include angle from 0 times.

[0086] Drawing 4 is some sectional views of the liquid crystal display in which the 3rd example of this invention is shown. The liquid crystal display of this example Dispersion/transparency mold liquid crystal cell 10 and the p-s wave separation reflecting plate 20 arranged at the tooth-back side of this liquid crystal cell 1, It consists of an anisotropy scattered plate 24 arranged between said liquid crystal cell 10 and said p-s wave separation reflecting plate 20, and absorption film 21 of the black system prepared in the tooth-back side of said p-s wave separation reflecting plate 20 as a light absorption member.

[0087] In addition, since the absorption film 21 which dispersion/transparency mold liquid crystal cell 10 is the thing of macromolecule distributed process input output equipment, and was prepared as this liquid crystal cell 10, the p-s wave separation reflecting plate 20, and a light absorption member is the same as the thing of the 1st example of the above, the overlapping explanation attaches and omits a same sign to drawing.

[0088] Drawing 5 is the side elevation of said anisotropy scattered plate 24, and this anisotropy scattered plate 24 has the property which are scattered about and carries out outgoing radiation of the light which carried out outgoing radiation of the light which carried out incidence by the incident angle in the specific include-angle range theta to perpendicularly [H] it was shown in drawing with the alternate long and short dash line, without being scattered on drawing as a continuous-line arrow head shows, and carried out incidence by the larger incident angle than it to drawing as a broken-line arrow head shows. In addition, the include-angle range theta of the light which carries out outgoing radiation, without scattering about these anisotropy scattered plates 24 is 30 degrees (it is 15 degrees to a perpendicular direction H).

[0089] Since said anisotropy scattered plate 24 is arranged between a liquid crystal cell 10 and the p-s wave separation reflecting plate 20 according to the liquid crystal display of this example, To drawing 5 , as the continuous-line arrow head showed, the light which carried out outgoing radiation to the tooth-back side of said liquid crystal cell 10 of the light which carried out incidence to said liquid crystal cell 10 from the front, and was scattered about by the liquid crystal layer 15 It condenses so that the light which goes to a perpendicular direction H with said anisotropy scattered plate 24 may increase. It can condense so that the light which goes to a perpendicular direction H with said anisotropy scattered plate 24 again may increase, and incidence of the light (s ****) furthermore reflected by the p-s wave separation reflecting plate 20 can be carried out to said liquid crystal layer 15 from the tooth-back side. Therefore, outgoing radiation of many scattered lights can be carried out according to the direction of a transverse plane which is the observation direction of a display, and clear display can be made still brighter.

[0090] Moreover, it condenses so that the light with which the light carried out incidence from the front, and penetrated the liquid crystal layer 15 of said liquid crystal cell 10 also at whose time of a dark display, and it carried out outgoing radiation to the tooth-back side in this liquid crystal display goes to a perpendicular direction H with said anisotropy scattered plate 24 may increase. Although the light which carries out outgoing radiation increases in the direction of a transverse plane and a dark display becomes to some extent bright in it since it condenses so that the light with which the light furthermore reflected by said p-s wave separation reflecting plate 20 goes to a perpendicular direction H with said anisotropy scattered plate 24 again may increase. On the other hand, since outgoing radiation light is the light scattered about with said anisotropy scattered plate 24, the moire of the dark display by reflection of p **** in said p-s wave separation reflecting plate in the case of a dark display can be controlled.

[0091] Incidence of the light is carried out [of the periphery centering on the normal of that front face] to this liquid crystal display from the perimeter by the incident angle of 20 degrees to said normal. When outgoing radiation light is measured from a transverse plane (direction which met said normal), the reflection factor (ratio of the outgoing radiation light to incident light) R of the light at the time of the clear display of equipment and a dark display, the chromaticity x of outgoing radiation light, y, and the contrast CR are as follows, respectively.

[0092] In addition, it is the value which the anisotropy scattered plate 24 used here is an anisotropy scattered plate by Sumitomo Chemical Co., Ltd. marketed by the trade name of

"MFX1515", and made 100% the reflection factor of this white reflecting plate on the basis of the reflection factor in the simple substance of the white reflecting plate with which said reflection factor R consists of aluminum 2O3, and the chromaticity of said outgoing radiation light is x coordination value and y coordination value on a CIE chromaticity diagram.

[0093] clear display R= 92.1% of reflection factors, a chromaticity x= 0.32, and y=0.33 dark display R= 25.4% of reflection factors, a chromaticity x= 0.30, and y=0.31 contrast CR=3.6 -- in this way Although contrast will fall to some extent if the liquid crystal display of this example is compared with the liquid crystal display of the 1st example mentioned above Since many outgoing radiation of the scattered light can be carried out according to the direction of a transverse plane which is the observation direction of a display, while giving an indication still brighter, the moire of the dark display by reflection of p **** in the p-s wave separation reflecting plate 20 in the case of a dark display can be controlled.

[0094] In addition, although the anisotropy scattered plate 24 is arranged in the 3rd example of the above between said liquid crystal cell 10 and the p-s wave separation reflecting plate 20 This anisotropy scattered plate 24 may be arranged to the front-face side of a liquid crystal cell 10 like the 4th example shown in drawing 6 . Also according to this example While carrying out many outgoing radiation of the scattered light according to the direction of a transverse plane which is the observation direction of a display and giving an indication still brighter, the moire of the dark display by reflection of p **** in the p-s wave separation reflecting plate 20 in the case of a dark display can be controlled.

[0095] The reflection factor R of the light at the time of the clear display of the liquid crystal display which has arranged the anisotropy scattered plate 24 to the front-face side of a liquid crystal cell 10 like this example, and a dark display, the chromaticity x of outgoing radiation light, y, and the contrast CR are as follows.

[0096] Clear display R= 93.4% of reflection factors, a chromaticity x= 0.32, y=0.33 dark display R= 30.3% of reflection factors, a chromaticity x= 0.30, and y=0.30 contrast CR=2.7 drawing 7 They are some sectional views of the liquid crystal display in which the 5th example of this invention is shown. The liquid crystal display of this example Two or more of the pixel fields are made to equip dispersion/transparency mold liquid crystal cell 10 with the color filters 18R, 18G, and 18B of three colors of the color filter of two or more colors which corresponds, respectively, for example, red, green, and blue.

[0097] Namely, dispersion/transparency mold liquid crystal cell 10 used in this example It has two or more pixel fields where the electrodes 13 and 14 prepared in the inside of the substrates 11 and 12 of a pair, respectively counter mutually. Either of the substrates 11 and 12 of said pair, for example, the inside of the front-face side substrate 11, is made to correspond to said two or more pixel fields, respectively, and the color filters 18R, 18G, and 18B of three colors of red, green, and blue are formed in it.

[0098] In addition, said dispersion/transparency mold liquid crystal cell 10 is the thing of macromolecule distributed process input output equipment, and this liquid crystal cell 10 of it is the same as that of the thing of the 1st example mentioned above when removing the point equipped with said color filters 18R, 18G, and 18B. Moreover, the absorption film 21 prepared as the p-s wave separation reflecting plate 20 and a light absorption member is the same as the thing of the 1st example.

[0099] According to the liquid crystal display of this example, as a dispersion/transparency mold liquid crystal cell 10, since the red corresponding to two or more of those pixel fields, green, and the thing equipped with the color filters 18R, 18G, and 18B of three blue colors are used, the bright good full color image of contrast can be displayed, respectively.

[0100] Although color filters 18R, 18G, and 18B are formed in the inside of the front-face side substrate 11 of a liquid crystal cell 10 in the above-mentioned example By forming said color filters 18R, 18G, and 18B in the inside of the tooth-back side substrate 12, and doing in this way Light of not coloring [which carries out outgoing radiation of the clear display by dispersion of light ahead of the scattered lights scattered about by the liquid crystal layer 15 of said liquid crystal cell 10], Color it the color of said said color filters 18R, 18G, and 18B, and outgoing radiation is carried out to the tooth-back side of a liquid crystal cell 10. It can display ahead of the scattered lights which were reflected by the p-s wave separation reflecting plate 20, and were again scattered about by said liquid crystal layer 15 by both light which carries out outgoing radiation, and a still brighter full color image can be displayed.

[0101] In addition, dispersion/transparency mold liquid crystal cell 10 equipped with said color filters 18R, 18G, and 18B may be used for any of the liquid crystal display of the 1st - the 4th example mentioned above.

[0102] Moreover, the thing of a phase transition mold which prepared the liquid crystal layer which a dielectric anisotropy becomes from

forward cholesteric liquid crystal, or cholesteric liquid crystal and the liquid crystal mixture of a pneumatic liquid crystal between the transparence substrates of not only the thing of macromolecule distributed process input output equipment but a pair is sufficient as said dispersion/transparency mold liquid crystal cell 10.

[0103] Furthermore, the thing of not only the thing of an active-matrix method but a simple matrix method is sufficient as said dispersion/transparency mold liquid crystal cell 10, and, in the case of the liquid crystal display of monochrome display, the thing of a segment method is sufficient as it.

[0104]

[Effect of the Invention] The liquid crystal display of this invention has the reflective shaft and transparency shaft which intersect perpendicularly with the tooth-back side of dispersion/transparency mold liquid crystal cell mutually. In order to reflect s **** of the polarization component in alignment with said reflective shaft, to arrange the p-s wave separation reflecting plate which makes p **** of the polarization component in alignment with said transparency shaft penetrate and to prepare a light absorption member in the tooth-back side of this p-s wave separation reflecting plate, Clear display by dispersion of incident light can be made bright enough, and, moreover, the good display of contrast can be obtained.

[0105] The light absorption member prepared in the tooth-back side of said p-s wave separation reflecting plate in the liquid crystal display of this invention has the desirable absorption film of the black system which absorbs most incident light, by using the absorption film of this black system, can lose nearly completely the light which penetrated said p-s wave separation reflecting plate being reflected, and carrying out outgoing radiation ahead, and can give said dark indication darker.

[0106] In addition, said light-absorption member absorbs the light of the polarization component in alignment with an absorption shaft, and the polarizing plate which makes the light of the polarization component in alignment with a transparency shaft penetrate is sufficient as it, and it can absorb the light which penetrated said p-s wave separation reflecting plate with said polarizing plate by arranging said polarizing plate in that case towards the direction which crosses the transparency shaft to the transparency shaft of said p-s wave separation reflecting plate.

[0107] Thus, when using a polarizing plate for said light absorption member, a light reflex member may be prepared in the tooth-back side of said polarizing plate, and said clear display can be made brighter by considering as such a configuration.

[0108] In this case, although a dark display also becomes to some extent bright Since incidence of the outdoor daylight is mainly carried out from the direction to which it inclined aslant to the direction of a transverse plane which is the observation direction of a display and it is reflected ahead [slanting] by said p-s wave separation reflecting plate and the light reflex member to the direction of a transverse plane at the time of clear display, The dark display observed from a transverse plane is sufficient darkness, therefore can obtain the good display of contrast with the difference of the brightness of clear display and a dark display large enough.

[0109] Furthermore, it sets to the liquid crystal display of this invention. Between said liquid crystal cell and said p-s wave separation reflecting plate or to the front-face side of said liquid crystal cell When it is desirable to arrange the anisotropy scattered plate which are scattered about and carries out outgoing radiation of the light which carried out outgoing radiation of the light which carried out incidence by the incident angle of specific include-angle within the limits to the perpendicular direction, without being scattered about, and carried out incidence by the larger incident angle than it and it does in this way While carrying out many outgoing radiation of the scattered light according to the direction of a transverse plane which is the observation direction of a display and giving an indication still brighter, the moire of the dark display by reflection of p **** in said p-s wave separation reflecting plate in the case of a dark display can be controlled.

[0110] Moreover, said liquid crystal cell can display the bright good multicolor color picture of contrast by having two or more pixel fields where the electrode prepared in the inside of the substrate of a pair, respectively counters mutually, preparing the color filter of two or more colors which corresponds to either of the substrates of said pair to said two or more pixel fields, respectively, and using such a liquid crystal cell.

[Brief Description of the Drawings]

[Drawing 1] Some sectional views of the liquid crystal display in which the 1st example of this invention is shown.

[Drawing 2] The perspective view of the p-s wave separation reflecting plate 20.

[Drawing 3] Some sectional views of the liquid crystal display in which the 2nd example of this invention is shown.

[Drawing 4] Some sectional views of the liquid crystal display in which the 3rd example of this

invention is shown.
[Drawing 5] The side elevation of an anisotropy scattered plate.
[Drawing 6] Some sectional views of the liquid crystal display in which the 4th example of this invention is shown.
[Drawing 7] Some sectional views of the liquid crystal display in which the 5th example of this invention is shown.
[Drawing 8] Some sectional views of the conventional dispersion mold liquid crystal display.
[Description of Notations]
10 -- Dispersion/transparency mold liquid crystal cell (polymer dispersed liquid crystal cel)
11 12 -- Substrate
13 14 -- Electrode
15 -- Liquid crystal layer (liquid crystal / macromolecule compound layer)
18R, 18G, 18B -- Color filter
20 -- p-s wave separation reflecting plate 20
21 -- Absorption film (light absorption member)
22 -- Polarizing plate (light absorption member)
23 -- Light reflex member
24 -- Anisotropy scattered plate